CIRCULAR DEQ 4

MONTANA STANDARDS

FOR SUBSURFACE WASTEWATER

TREATMENT SYSTEMS

2002 Edition

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FOREWORD

These standards, based on proven technology, set forth requirements for the design and preparation of plans and specifications for subsurface wastewater treatment systems.

Users of these standards need to be aware that subsurface wastewater treatment systems are considered by the Environmental Protection Agency to be Class V injection wells and may require associated permits. Of particular concern are systems receiving wastewater from industries and automotive service stations.

These standards are a revision of the Department's Circulars WQB-4, WQB-5, and WQB-6, 1992 Editions and Circular DEQ 4, 2000 Edition.

CIRCULAR DEQ-4

CHAPTERS

CHAPTER 1

APPLICABILITY

1.1. These minimum standards apply to all subsurface wastewater treatment systems in Montana. In some cases, a reviewing authority (other than the Department of Environmental Quality) may have requirements that are more stringent than those set out in this circular.

The term "reviewing authority," as used in these standards, refers to the Montana Department of Environmental Quality, a division of local government delegated to review public wastewater systems pursuant to Administrative Record of Montana (ARM) 17.38.102, a local unit of government that has adopted these standards pursuant to Section 76-3-504, Montana Code Annotated (MCA), or a local board of health that has adopted these standards pursuant to Section 50-2-116, MCA.

1.2. Types of systems

This circular describes different types of wastewater treatment and disposal systems for use in subsurface effluent discharge. These systems include standard absorption trenches, deep absorption trenches, at-grade absorption trenches, sand-lined absorption trenches, gravelless absorption trenches, elevated sand mounds, intermittent sand filters, recirculating sand filters, recirculating trickling filters, evapotranspiration absorption systems, evapotranspiration systems, aerobic wastewater treatment units, chemical nutrient reduction systems, and experimental systems. Systems providing advanced treatment or greater separation to a limiting layer may be used where standard absorption trenches are acceptable. Many of these systems also have specific application to solving particular problems. The list below is a partial list intended to assist in problem solving for a particular set of site conditions.

1.2.1 System uses

1.2.1.1 Deep absorption trenches are used to break through an impervious soil layer and allow effluent to infiltrate a deeper and more permeable soil. The bottom of the trench must not be more than 5 feet below natural ground surface.

1.2.1.2 At-grade absorption trenches are used to achieve the minimum separation distance between the bottom of the trench and a limiting layer and may be used as long as the 4-foot separation can be maintained. These systems may be used only for residential strength wastewater and for flows not exceeding 500 gallons per day.

1.2.1.3 Sand-lined absorption trenches are used where the percolation rate is faster than 3 minutes per inch or for rapid or slow permeability situations.

1.2.1.4 Gravelless absorption trenches are used in lieu of standard absorption trenches within the limitations provided in this circular.

1.2.1.5 Elevated sand mounds are used to provide advanced treatment of septic tank effluent and/or to achieve the minimum separation distance between the bottom of the drain rock and a limiting layer.

1.2.1.6 Intermittent sand filters are used to provide advanced treatment of septic tank effluent and are typically used on small systems.

1.2.1.7 Recirculating sand filters are used to provide advanced treatment of septic tank effluent and are typically used on large wastewater systems.

1.2.1.8 Recirculating trickling filters are used to provide advanced treatment of septic tank effluent.

1.2.1.9 Evapotranspiration absorption systems are used where slow percolation rates or soil conditions would preclude the use of a standard absorption trench.

1.2.1.10 Evapotranspiration systems are used where slow percolation rates or soil conditions would preclude the use of a standard system.

1.2.1.11 Aerobic wastewater treatment units are used to provide advanced treatment of septic tank effluent or to provide treatment equal to or better than a septic tank. They may also be used to provide treatment of high strength wastewater.

1.2.1.12 Chemical nutrient reduction systems are used to provide advanced treatment of septic tank effluent.

The monitoring frequency must be sufficient to establish the treatment efficiency and response to varying wastewater flows, strengths, and climatic conditions.

The Department will consider the complexity and maintenance required of the system, the stability of the processes, and the monitoring data in determining the adequacy, level of maintenance, and monitoring frequency of the system.

1.2.1.13 Absorption beds, holding tanks, sealed pit privies, unsealed pit privies, and seepage pits may only be used as specified in Department regulations. These systems are not allowed as new systems in subdivisions unless authorized by the regulations. Typically, these systems are subject to limited areas, used as replacement systems, or are used in areas where other systems cannot be used.

1.3 Deviations

1.3.1 Deviations from the mandatory requirements of this circular may be granted by the reviewing authority having jurisdiction on a case-by-case basis for specific projects. The terms **shall, must,** and **may not** are used where practice is sufficiently standardized to permit specific delineation of requirements or where safeguarding of the public health justifies such definite action. These mandatory items serve as a checklist for the reviewing authority. Other terms, such as **should, may, recommended,** and **preferred**, indicate desirable procedures or methods. These nonmandatory items serve as guidelines for designers.

1.3.2 Procedure

1.3.2.1 A person desiring a deviation shall make a request in writing to the reviewing authority having jurisdiction and shall include the appropriate review fee. The request must identify the specific section of the circular to be considered. Adequate justification for the deviation must be provided. “Engineering judgment” or “professional opinion” without supporting data must be considered inadequate justification. The justification must address the following issues:

A. The system that would be allowed by the deviation would be unlikely to cause pollution of state waters in violation of 75-5-605, MCA;

B. The granting of the deviation would protect the quality and potability of water for public water supplies and domestic uses and would protect the quality of water for other beneficial uses, including those uses specified in 76-4-101, MCA; and

C. The granting of the deviation would not adversely affect public health, safety, and welfare.

1.3.2.2 The reviewing authority having jurisdiction will review the request and make final determination on whether a deviation may be granted.

1.3.2.3 A file of all deviations must be maintained by the reviewing authority.

CHAPTER 2

DEFINITIONS

2.1 **Absorption area** means that area determined by multiplying the length and width of the bottom area of the disposal trench.

2.2 **Absorption bed** means an absorption system that consists of excavations greater than 3 feet in width where the distribution system is laid for the purpose of distributing pretreated waste effluent into the ground.

2.3 **Absorption system** means any secondary treatment system including absorption trenches, elevated sand mounds, and evapotranspiration absorption (ETA) systems used for subsurface disposal of pretreated waste effluent.

2.4 **Absorption trench** means an absorption system that consists of excavations less than or equal to 3 feet in width where the distribution system is laid for the purpose of distributing pretreated waste effluent into the ground.

2.5 **Advanced treatment** means a treatment process that provides effluent quality in excess of primary treatment.

2.6 **Aerobic wastewater treatment unit** means a wastewater treatment plant that incorporates a means of introducing air and oxygen into the wastewater so as to provide aerobic biochemical stabilization during detention period. Aerobic wastewater treatment facilities may include anaerobic processes as part of the treatment system.

2.7 **Bedrock** mean material that cannot be readily excavated by hand tools, or material that does not allow water to pass through or that has insufficient quantities of fines to provide for the adequate treatment and disposal of wastewater.

2.8 **Bedroom** means any room that is or may be used for sleeping. An unfinished basement is considered as an additional bedroom.

2.9 **BOD_5** (five-day biochemical oxygen demand) means the quantity of oxygen used in the biochemical oxidation of organic matter in 5 days at 20 degrees centigrade under specified conditions and reported as milligrams per liter (mg/L).

2.10 **Building drain** means the pipe extending from the interior plumbing to a point 2 feet outside the foundation wall.

2.11 **Building sewer** means the pipe connecting the house or building drain to the public sewer or private sewer.

2.12 **Cleanout** means an access to a sewer line at least 4 inches in diameter, extending from the sewer line to the ground surface or inside the foundation, used for access to clean a sewer line.

2.13 **Chemical nutrient reduction** means a wastewater treatment system that incorporates the systematic addition of one or more chemicals into the effluent in order to reduce the concentration of one or more chemical components (such as nitrate or phosphorus).

2.14 **Design flow** means the peak flow (daily or instantaneous, as appropriate) for sizing hydraulic facilities, such as pumps, piping, storage, and absorption systems and means the average daily flow for sizing other treatment systems.

2.15 **Distribution box** means a watertight receptacle that receives septic tank effluent and distributes it equally into two or more pipes leading to the absorption area.

2.16 **Distribution pipe** means a perforated pipe used in the dispersion of septic tank or other treatment facility effluent into disposal trenches, seepage trenches, or seepage beds.

2.17 **Dosing frequency** means the number of times per day that effluent is applied to an absorption system, drainfield, sand filter, or sand mound, or to a section of an absorption system, drainfield, sand filter, or sand mound.

2.18 **Dosing tank** means a watertight receptacle receiving effluent from the septic tank or after another treatment device, equipped with an automatic siphon or pump designed to discharge effluent.

2.19 **Dosing volume** means the volume of effluent (in gallons) applied to an absorption system, drainfield, sand filter, or sand mound each time a pump is turned on or each time a siphon functions.

2.20 **Drain rock** means the rock or coarse aggregate used in an absorption system, drainfield, sand mound, or sand filter. Drain rock must be washed, be a maximum of 2 ½ inches in diameter and larger than the orifice size unless shielding is provided to protect the orifice, and contain no more than 2 percent passing the No. 8 sieve. The material must be of sufficient competency to resist slaking or dissolution. Gravels of shale, sandstone, or limestone may degrade and may not be used.

2.21 **Dwelling or residence** means any structure, building, or portion thereof, which is intended or designed for human occupancy and supplied with water by a piped water system.

2.22 **Effective size** means the sieve size in millimeters (mm) allowing only 10 percent of the material to pass as determined by wet-test sieve analysis method ASTM C117-95.

2.23 **Effluent** means partially treated wastewater from a septic tank or other treatment facility.

2.24 **Effluent filter** means an effluent treatment device installed on the outlet of a septic tank designed to prevent the passage of suspended matter larger than 1/8 inch in size.

2.25 **Fats, oils, grease (FOG)** means a component of wastewater typically originating from food stuffs (animal fats or vegetable oils) or consisting of compounds of alcohol or glycerol with fatty acids (soaps and lotions).

2.26 **Gravity dose** means a known volume (dose) of effluent that is delivered to an absorption system in a specific time interval. The effluent may be delivered either by a siphon or by a pump to a distribution box or manifold.

2.27 **Gray water** means a wastewater other than toilet wastes or industrial chemicals, including, but not limited to, shower and bath wastewater, kitchen wastewater, and laundry wastewater.

2.28 **Grease trap** means a device designed to separate grease and oils from the effluent.

2.29 **High-strength waste** means effluent from a septic tank or other treatment device that has BOD_5 greater than 300 mg/L, and/or TSS greater than 150mg/L, and/or fats, oils, and grease greater than 25mg/L.

2.30 **Impervious layer** means any layer of material in the soil profile that has a percolation rate slower than 120 minutes per inch.

2.31 **Individual wastewater system** means a wastewater system that serves one living unit or commercial structure. The total number of people served may not exceed 24.

2.32 **Infiltrative surface** means the soil interface that receives the effluent wastewater below the drain rock or sand.

2.33 **Influent** means the wastewater flow stream prior to any treatment.

2.34 **Manhole** means an access to a sewer line for cleaning or repair, with requirements as defined in Department Circular DEQ-2, 1999 Edition.

2.35 **Manifold** means a solid (nonperforated) main wastewater line that distributes effluent to individual distribution pipes.

~~2.36~~ **Multiple-user** wastewater system means a nonpublic wastewater system that serves, or is intended to serve, three through 14 living units or three through 14 commercial structures. The total population served may not exceed 24. In estimating the population served, the reviewing authority shall multiply the number of living units times the county average of persons per living unit based on the most recent census data.

2.37 **Passive nutrient reduction** means a wastewater treatment system, other than elevated sand mound, intermittent sand filter, or recirculating sand filter, that reduces the effluent concentration of one or more components (such as nitrate or phosphorus) without the addition of chemicals and without mechanical aeration.

2.38 **Percolation test** means a standardized test used to assess the infiltration rate of soils.

2.39 **Pressure distribution** means an effluent distribution system where all pipes are pressurized, the head at any orifice is at least 1 pound per square inch (psi) and not more than 6 psi, and the effluent is pumped (or delivered by siphon) to the next portion of the treatment system in a specific time interval.

2.40 **Pretreatment** means the wastewater treatment that takes place prior to discharging to any component of a wastewater treatment and disposal system, including, but not limited to, pH adjustment, oil and grease removal, BOD_5 and TSS reduction, screening, and detoxification.

2.41 **Primary treatment** means a treatment system that provides retention time to settle the solids in raw wastewater and that retains scum within the system.

2.42 **Private sewer** means a sewer receiving the discharge from one building sewer and conveying it to the public sewer system or a wastewater treatment system.

2.43 **Public wastewater system** means a system for collection, transportation, treatment, or disposal of wastewater that serves 15 or more families or 25 or more persons daily for a period of at least 60 days in a calendar year. In estimating the population served, the reviewing authority shall multiply the number of living units times the county average of persons per living unit based on the most recent census data.

2.44 **Residential strength wastewater** means effluent from a septic tank or other treatment device with a BOD_5 less than or equal to 300 mg/L, TSS less than or equal to 150 mg/L, and fats, oils, and grease less than or equal to 25 mg/L.

2.45 **Reviewing authority** means the Department of Environmental Quality, a local department or board of health certified conduct review under 76-4-104, MCA; a division of local government delegated to review public wastewater systems pursuant to ARM 17.38.102; a local unit of government that has adopted these standards pursuant to 76-3-504, MCA; or a local board of health that has adopted these standards pursuant to 50-2-116, MCA.

2.46 **Secondary treatment** means a biological treatment process coupled with solid/liquid separation. The effluent from secondary treatment should generally have a BOD_5 less than 30 mg/L and TSS less than 30 mg/L.

2.47 **Septic tank** means a storage settling tank in which settled sludge is in immediate contact with the wastewater flowing through the tank while the organic solids are decomposed by anaerobic action.

2.48 **Sewage** is synonymous with "wastewater" for purposes of this circular.

2.49 **Sewer invert** means inside bottom (or flow line) of a sewer pipe.

2.50 **Shared wastewater system** means a wastewater system that serves or is intended to serve two living units or commercial structures**.** The total number of people served may not exceed 24. In estimating the population served, the reviewing authority shall multiply the number of living units times the county average of persons per living unit based on the most recent census data.

2.51 **Siphon** means a pipe fashioned in an inverted U shape and filled until atmospheric pressure is sufficient to force a liquid from a reservoir in one end of the pipe over a barrier and out the other end. Siphons are sometimes used to gravity-dose an absorption system from a dosing tank or chamber.

2.52 **Synthetic drainage fabric** means a nonwoven drainage fabric with a minimum weight per square yard of 4 ounces, a water flow rate of 100 to 200 gallons per minute per square foot, and an apparent opening size equivalent to a No. 50 to No. 110 sieve.

2.53 **Tertiary treatment** means additional removal of colloidal and suspended solids by chemical coagulation and/or medium filtration for the reduction of nutrients.

2.54 **TSS (Total Suspended Solids)** means solids in wastewater that can be removed by standard filtering procedures in a laboratory and is reported as milligrams per liter (mg/L).

2.55 **Uniformity coefficient** (UC) means the sieve size in millimeters (mm) that allows 60 percent of the material to pass (D60), divided by the sieve size in mm allowing 10 percent of the material to pass (D10), as determined by ASTM C117-95 (UC=D60/D10).

2.56 **Uniform distribution** is a means to distribute effluent into a sand filter, sand mound, or absorption system such that the difference in flow (measured in gallons per day per square foot) throughout the absorption system, sand filter, or sand mound is less than 10 percent.

2.57 **Wastewater** means water-carried waste that is discharged from a dwelling, building, or other facility, including household, commercial, or industrial wastes; chemicals; human excreta; or animal and vegetable matter in suspension or solution.

CHAPTER 3

SITE EVALUATION

3.1 Information concerning soil and site conditions is needed for the design of subsurface wastewater treatment systems. Those factors which must be evaluated are thickness of permeable soil above seasonally high ground water, bedrock or other limiting layer, soil properties, land slope, topographic position, flooding hazard and amount of suitable area available, and setback distances required in ARM Title 17, chapter 36, subchapter 3 or 9. For systems with a design wastewater flow greater than 1,000 gallons per day, the potential for ground water mounding must be evaluated.

3.2 Evaluation of soil factors

Soil properties must be evaluated using a soil profile and must be supported by percolation tests, soils maps, and other available scientific information when variability of the soils indicates additional information is necessary to determine the appropriate application rate.

3.3 Existing soil information

Soil surveys are usually found at the local USDA Natural Resources Conservation Service (NRCS) office. Soil surveys offer good preliminary information about an area and can be used to identify potential problems; however, they cannot substitute for a field investigation.

3.4 Soil profile descriptions

3.4.1 Soil pits within 25 feet of the boundaries of the proposed absorption system are required for soil descriptions. For proposed primary and replacement absorption systems that are not located in the same immediate area, a soil profile may be required for each proposed absorption system area. The minimum depth of soil profile descriptions must be 8 feet unless a limiting layer is encountered at a shallower depth. The soil profile may be completed to a greater depth to demonstrate compliance with nondegradation rules for phosphorous breakthrough.

3.4.2 The following soil properties must be evaluated to the full depth of the holes and reported:

3.4.2.1 Thickness of layers or horizons;

3.4.2.2 Texture, structure, and consistence of soil horizons;

3.4.2.3 Color (preferably described by using the notation of the Munsell color scheme) and color variation (redoximorphic features);

3.4.2.4 Depth of water, if observed;

3.4.2.5 Estimated depth to seasonally high ground water and basis for the estimate;

3.4.2.6 Depth to and type of bedrock, if observed;

3.4.2.7 Stoniness reported on a volume basis (i.e. the percentage of the soil volume occupied by particles greater than 2 mm in diameter);

3.4.2.8 Plasticity; and

3.4.2.9 Other prominent features such as roots, etc.

3.5 Percolation tests

3.5.1 Percolation tests, if required, must be conducted at the approximate depth of proposed construction. For elevated sand mounds and at-grade systems, the depth of the percolation test hole must be 12 inches. Additional percolation tests may be required to determine the existence of a limiting layer. The percolation tests must be performed in accordance with the procedures contained in Appendix A. When the proposed replacement area is not immediately adjacent to the primary absorption system, at lease one percolation test must be conducted within the boundaries of the replacement area.

3.5.2 When more than one percolation test is conducted within the boundaries of a proposed absorption system, the percolation rate will be determined based on the arithmetic mean of the percolation test values.

3.6 Site factors

The land slope, potential for flooding and surface water concentration, and amount of suitable area must be evaluated.

3.6.1 Type and percent of land slope

The type (concave, convex, or plane), percent, and direction of land slope must be reported, along with the method of determination.

3.6.2 Flooding and surface water

The potential for flooding or accumulation of surface water from storm events must be evaluated.

3.6.3 Ground water quality impact

Compliance with the nondegradation requirements of the Montana Water Quality Act (75-5-301, MCA) must be demonstrated.

3.6.4 Ground water monitoring

When required, ground water monitoring must be conducted in accordance with Appendix C.

CHAPTER 4

SITE MODIFICATIONS

Site modifications, as described in this chapter, may only be used for replacement of failing systems. The following systems may not be used for new systems in subdivisions, although cut systems and fills systems may be used for replacement areas for new subdivisions, provided the site preparation (cut or fill) is completed prior to approval.

4.1 Artificially drained site

4.1.1 General

Prior to construction of any site drainage system such as field drain, under drain, or vertical drain, an evaluation of the site must be performed, including soil profile descriptions; slope; depth to bedrock or impervious layer; estimation of depth to seasonally high ground water; topography; distance to wells, seeps, streams, ponds, or other open water; and any other pertinent considerations.

4.1.2 Design of drain system

4.1.2.1 The drainage method chosen (curtain drain, vertical drain, or under drain) and the reason for this choice must be detailed. Drawings showing dimensions of the drain system and materials to be utilized must be provided.

4.1.2.2 The drainage system must be constructed according to the specific design approved by the reviewing authority.

4.1.3 The type of wastewater treatment system to be approved must depend upon the depth to seasonally high ground water. A minimum of 4 feet from the bottom of the trench over the entire area of the proposed absorption system and replacement area to the seasonally high ground water must have been achieved by the site drainage system. An adequate horizontal separation distance must be maintained between the drain and the absorption system in order to reduce the potential for effluent to enter the drain.

4.1.4 The reviewing authority may require monitoring of the depth to seasonally high ground water after installation of the drainage system.

4.2 Cut systems

4.2.1 Limitation

Absorption trenches for these systems must meet the same requirements as a standard absorption trench.

4.2.2 Design

4.2.2.1 Cut areas for the replacement absorption system must be physically completed prior to approval. Two soil test holes must be excavated and detailed soil profile descriptions must be provided. Percolation tests may be required after the cut has been completed.

4.2.2.2 A complete lot layout must be submitted showing the cut areas, the uphill and downhill slope, and slope across the cut area. Slope across the absorption system site must be a uniform slope.

4.2.2.3 Cut systems will only be considered on slopes that do not exceed 25 percent and where downhill slope below the cut area is not greater than 25 percent.

4.2.3 Report

The designer shall submit a letter of verification indicating that the site meets minimum requirements of applicable rules after the cut has been completed.

4.3 Fill system

4.3.1 Location

4.3.1.1 Any parcel that will undergo land modification by filling must have enough area suitable for absorption system placement. The entire area necessary for the replacement absorption system must be filled prior to final approval of the system.

4.3.1.2 Fill systems may not be installed on soils with a percolation rate slower than 60 minutes per inch. Side slopes on the fill may not exceed 25 percent (4:1).

4.3.2 Fill material

Soils used for fill may not be finer than sandy loam with a maximum of 20 percent passing the No. 100 sieve.

4.3.3 Design

4.3.3.1 System configuration, dimensions, and orientation must be approved by the reviewing authority prior to the placement of fill material.

4.3.3.2 Fill must be of suitable depth to provide the minimum separation distances from the finished ground surface to a limiting layer. Fill cannot be used to overcome minimum vertical or horizontal separation distances.

4.3.3.3 Three percolation tests evenly spaced across the completed fill must be performed at the depth of the proposed infiltrative surface as a basis for design application rate.

4.3.3.4 The absorption system must be sized on the basis of the percolation rate for either the soil beneath the fill material or the percolation rate of the fill material, whichever is slower.

4.3.4 Construction

4.3.4.1 All vegetative cover must be removed for the area to be filled.

4.3.4.2 Fill material must not be put in place when the fill or the original soil surface is frozen.

4.3.4.3 Fill material must be placed in lifts specified by the engineer to obtain stable soil structure conditions.

4.3.4.4 Absorption trenches must be set back at least 24 feet from the lower edge of the filled area on slopes of 6 percent or greater. For slopes less than 6 percent, absorption trenches must be set back at least 3 feet on all sides prior to starting the side slope.

4.3.4.5 The fill area must be seeded with a suitable grass to aid in stabilization.

CHAPTER 5

WASTEWATER FLOW

The purpose of this chapter is to provide a method for estimating wastewater flows.

5.1 Residential wastewater flows

Design wastewater flow for residential dwelling units must be in accordance with the following table. Single-family dwelling units will be considered to have three bedrooms unless otherwise approved.

1 bedroom	150 gpd
2 bedrooms	225 gpd
3 bedrooms	300 gpd
4 bedrooms	350 gpd
5 bedrooms	400 gpd
Each additional bedroom	add 50 gpd

5.2 Nonresidential wastewater flow

5.2.1 Typical daily flows for a variety of commercial, institutional, and recreational establishments are presented in Tables 5-1 and 5-2. For design purposes, the typical flows must be used as minimum design flows. Greater design flows may be required where larger flows are likely to occur, such as resort areas. Design flow must be computed using the total number of units in the proposed facility times the typical daily flow in the tables, with no reduction allowed for occupancy rates. Where the system includes several different types of uses from the tables, each use must be computed separately, and the design flow must be based on the sum of all of the uses. A means of flow measurement (such as flow meters or pump run-time meters) may be required.

5.2.2 As an alternative to the flows listed in the tables, design flow may be based on actual water use data from similar facilities. If daily flows are used, the design flow must be 1.1 times the highest daily flow. If monthly averages are used, the peak design flow must be a minimum of 1.5 times the average flow of the highest month. The water use data must be representative of the facility proposed and for a time period adequate to evaluate annual use of the system. System components may be added (or enlarged) to address peak flows to allow absorption systems to be sized based on average flow.

5.3 Gray water

Gray water must be provided the same treatment required for other wastewater.

5.4 Wastewater strength

Subsurface wastewater disposal systems must be used only for residential strength wastewater. Wastewater exceeding the limits for residential strength wastewater must be pretreated to residential strength prior to discharging to DEQ-4 systems. Effluent from recreational vehicle holding tanks have BOD_5 levels as high as 15 times that of residential strength wastewater and must be pretreated accordingly. High strength waste must be pretreated with recirculating sand filters and aerobic treatment units or other systems specifically designed to reduce high strength wastewater to residential strength wastewater. For design, construction, operation and maintenance of system that treat high strength wastewater, please refer to the Onsite Wastewater Treatment Systems Manual, EPA/625/R-00/008, February 2002.

TABLE 5-1
TYPICAL WASTEWATER FLOWS FROM COMMERCIAL, INDUSTRIAL, AND OTHER NONRESIDENTIAL SOURCES

Source	Unit	Wastewater Range	Flow, gpd/unit Typical
Airport	Passenger	2-4	3
Automobile Service Station	Vehicle Served	7-13	10
	Employee	9-15	12
Bar	Customer	5	3
	Employee	10-16	13
Church	Seat		3
(Not including a kitchen, food service facility, daycare, or camp)			
Church	Seat		5
(Including kitchen, but not including a food service facility, day care, or camp)			
Daycare	Child	10-30	25
	Employee	10-20	15
Department Store	Toilet Room	400-600	500
	Employee	8-12	10
Hospital, medical	Bed	125-240	165
	Employee	5-15	10
Hospital, mental	Bed	75-140	100
	Employee	5-15	10
Hotel/Motel	Guest	40-56	48
	Employee	7-13	10
Industrial Building	Employee	10-16	13
(Sanitary waste only)			
Laundry	Machine	450-650	580
(Self-serve)	Wash	45-55	50
Office	Employee	7-16	13
Prison	Inmate	75-150	115
	Employee	5-15	10
Rest home	Resident	50-120	85
Restaurant	Meal	2-4	3
School, day:			
With cafeteria, gym, showers	Student	15-30	25
With cafeteria only	Student	10-20	15
Without cafeteria, gym, showers	Student	5-17	11
School, boarding	Student	50-100	75
Shopping Center	Parking Space	1-2	2
	Employee	7-13	10
Store	Customer	1-4	3
	Employee	8-12	10

TABLE 5-2
TYPICAL WASTEWATER FLOWS FROM RECREATIONAL FACILITIES

Source	Unit	Wastewater Range	Flow, gpd/unit Typical
Apartment, resort	Person	50-70	60
Bed and Breakfast	Person	20 - 40	40
Cabin, resort	Person	8-50	40
Cafeteria	Customer	1-3	2
	Employee	8-12	10
Campground (developed)	Person	20-40	30
Cocktail lounge	Seat	12-25	20
Coffee shop	Customer	4-8	6
	Employee	8-12	10
Country club	Member present	60-130	100
	Employee	10-15	13
Day camp (no meals)	Person	10-15	13
Dining hall	Meal served	4-10	7
Dormitory, bunkhouse	Person	20-50	40
Hotel/Motel, resort	Person	40-60	50
Store, resort	Customer	1-4	3
	Employee	8-12	10
Swimming pool	Customer	5-12	10
	Employee	8-12	10
Theater	Seat	2-4	3
Visitor center	Visitor	4-8	5
Travel trailer parks without individual hookups for water or sewer	Space		50
Travel trailer parks with individual hookups for water and/or sewer	Space		100

5.5 Waste segregation

5.5.1 General

Waste segregation systems consist of dry disposal for human waste, such as various chemical and incinerator type systems with separate disposal for gray water. However, regardless of the type of dry disposal system used, the gray water must be disposed of using an approved wastewater treatment system, with no flow or size reduction allowed for the waste segregation.

5.5.2 Location

A complete layout showing the location of the absorption system and 100 percent replacement site must be provided.

5.5.3 Maintenance

Final sludge disposal must be in compliance with federal regulations, 40 CFR Part 503.

CHAPTER 6

DESIGN OF SEWERS

6.1 Separation of water and sewer mains

6.1.1 Sewer mains and water mains are lines that serve more than one building or living unit.

6.1.2 Sewer mains must be at least 10 feet horizontally from any existing or proposed water main. The distance must be measured edge to edge.

6.1.3 Sewers mains crossing water mains must be laid to provide a minimum vertical distance of 18 inches between the outside of the water line and the outside of the sewer. This must be the case whether the water line is above or below the sewer. The crossing must be arranged so that the sewer joints will be equidistant and as far as possible from the water line joints.

6.2 Sewer size, slope, and design flows for building and private sewers

6.2.1 Only wastewater must be placed into the sewer system. Rainwater from roofs, streets, and other areas, as well as ground water from foundation drains, and back flush water from water softeners must be excluded.

6.2.2 Flow used for designing sewers must consider ultimate population to be served, maximum hourly wastewater flow, and possible infiltration.

6.2.3 A building sewer or private sewer from the structure to the septic tank must be at least 4 inches in diameter and must be placed at a minimum slope of ¼ inch per foot toward the point of discharge unless pressurized. Sewers that are larger than 4 inches in diameter must be designed in conformance with the requirements of Circular DEQ-2, 1999 Edition.

6.2.4 Sewers should be designed to prevent freezing.

6.3 Sewer materials

6.3.1 Building or private sewers must be PVC.

6.3.2 PVC sewer pipe must meet the requirements of ASTM D 3034, Schedule 40, or Schedule 80 and meet ASTM D 1785 and must be joined by an integral bell-and-spigot joint with rubber elastomeric gasket or solvent cement joints. When using ASTM D 3034, rock-free bedding is required. Schedule 40 pipe must be used leading into and out of the septic tank in the area of backfill around the tank for a minimum length of at least 10 feet.

6.3.3 Transition connections to other materials must be made by adapter fittings or one-piece molded rubber couplings with appropriate bushings for the respective materials. All fittings must be at least of equivalent durability and strength of the pipe itself.

6.4 Sewer installation

6.4.1 Sewers must be installed at a uniform slope Cleanouts and/or manholes are recommended within 3 feet of the building, for angles greater than 45 degrees, and for solid pipe runs greater than 100 feet in length.

6.4.2 Installation specifications must contain appropriate requirements based on the criteria, standards, and requirements established by the industry in its technical publications. Requirements must be set forth in the specifications for the methods of bedding and backfilling the pipe.

6.5 Cleanouts and manholes

6.5.1 Manholes must be installed on multiple-user and public gravity systems at the end of lines; at all changes in grade, size, or alignment; and at distances not greater than 400 feet.

6.5.2 The minimum inside dimension of manholes must be 48 inches.

6.5.3 The flow channel through manholes must be made to conform in shape and slope to that of the sewers.

6.5.4 Manholes must meet all the requirements of Department Circular DEQ-2, 1999 Edition.

6.5.5 Inlet and outlet pipes must be joined with a gasketed, flexible, watertight connection or any watertight connection arrangement that allows differential settlement of the pipe and manhole wall to take place. A bell-and-spigot pipe joint with rubber sealing ring, located within 12 inches of the manhole wall, satisfies this requirement.

6.5.6 Cleanouts may not be used in place of manholes on mains of public wastewater systems conveying raw wastewater. Where cleanouts are allowed by deviation, they may be used only for special conditions and at spacing not exceeding 150 feet.

6.5.7 Cleanouts should generally be used in place of manholes on lines conveying septic tank effluent. For systems conveying septic tank effluent, manholes must be located at major junctions of three or more pipes and should be limited to strategic locations for cleaning purposes.

6.6 Wastewater pumping stations

6.6.1 Wastewater pumping stations receiving wastewater that has not had settleable solids removed and that have design flow rates of 5,000 gpd or greater must be designed in accordance with Department Circular DEQ-2, 1999 Edition.

6.6.2 Wastewater pumping stations receiving wastewater that has not had settleable solids removed and that have design flow rates less than 5,000 gpd must be designed in accordance with Department Circular DEQ-2, 1999 Edition, with the following exceptions.

6.6.2.1 Pumps must be capable of passing spheres of at least 2 inches in diameter, or grinder pumps capable of handling raw wastewater must be provided.

6.6.2.2 Discharge lines must be at least 2 inches in diameter if the pump is capable of passing a 2-inch sphere. The discharge line must be sized to provide a minimum velocity of 2 feet per second.

6.6.2.3 Submersible pumps and motors must be designed specifically for totally submerged operation and must meet the requirements of the National Electric Code for such units. In addition, the design must provide for the pumps and motors to be totally submerged at all times.

6.6.2.4 Multiple pumps are not required.

6.6.2.5 A 4-inch pump is not required.

6.6.3 Stations receiving wastewater from private sewers that have had the settleable solids removed must be provided with pumps and controls that are corrosion resistant and are listed by Underwriters Laboratories, Canadian Standards Association, or other approved testing and/or accrediting agency as meeting the requirements for National Electric Code Class I, Division 2 locations. As an alternative, submersible pumps and motors must be designed specifically for totally submerged operation and meet the requirements of the National Electric Code for such units. In addition, the design must provide for the pumps and motors to be totally submerged at all times. An audible or visible alarm must be provided to indicate failure of the system.

CHAPTER 7

SEPTIC TANKS

A septic tank consists of one or more chambers providing primary treatment. All wastewater treatment systems must provide at least primary treatment prior to disposal in an absorption system or sand mound.

7.1 General

All wastewater must discharge into the septic tank.

Roof, footing, garage, surface water drainage, backwash water from water softeners, and cooling water must be excluded.

The septic tank must be located where it is readily accessible for inspection and maintenance.

7.2 Design

7.2.1 Septic tanks must be made of materials resistant to the corrosive environment found in septic tanks. The empty tank must be structurally sound and capable of withstanding loads created by 6 feet of burial over the top of the tank. Tanks must be installed in accordance with manufacturer's recommendations.

7.2.2 The walls and floor of concrete tanks must be at least 3 inches thick if adequately reinforced with steel and at least 6 inches thick if not reinforced. Concrete for septic tanks must have a water/cement ratio less than 0.45, a 28-day compressive strength of at least 4,000 psi, and must be made with sulfate-resistant cement (tricalcium aluminate content of less than 8 percent).

7.2.3 Concrete covers must be at least 3 inches thick and adequately reinforced. Access lids must be at least 2 inches thick.

7.2.4 Liquid connection between compartments shall consist of a single opening completely across the compartment wall or two or more openings equally spaced across the wall. The total area of openings shall be at least three times the area of the inlet pipe.

7.2.5 Inlets

7.2.5.1 The inlet into the tank must be at least 4 inches in diameter and enter the tank 3 inches above the liquid level. The inlet connection must be watertight.

7.2.5.2 The inlet of the septic tank and each compartment must be submerged by means of a vented tee or baffle. Tees and baffles must extend below the liquid level to a depth where at least 10 percent of the tank's liquid volume is above the bottom of the tee or baffle.

7.2.5.3 Vented tees or baffles must extend above the liquid level a minimum of 7 inches.

7.2.5.4 Baffle tees must extend horizontally into the tank to the nearest edge of the riser access to facilitate baffle maintenance.

7.2.6 Outlets

7.2.6.1 Outlets must include an effluent filter approved by the reviewing authority and complying with 7.2.7 below. On combination septic/dosing tanks, the septic tank outlet is considered to be in the wall dividing the septic compartment(s) and the dosing compartment.

7.2.6.2 The outlet of the tank must be at least 4 inches in diameter. The outlet connection must be watertight.

7.2.6.3 Each compartment of the septic tank must be vented.

7.2.6.4 Effluent filter inlets must be located below the liquid level at a depth where 30 to 40 percent of the tank's liquid volume is above the intake of the filter.

7.2.7 Effluent filters

7.2.7.1 Effluent filters must be used in all systems prior to secondary treatment devices unless the reviewing authority approves another filtering device such as a screened pump vault. The effective opening in the effluent filter must be no larger than 1/8-inch.

7.2.7.2 The minimum filter must provide a minimum clean water flow rate of 4.2 gallons per minute when tested in a setup that places the filter in its operation position and the clean water head is at the center of a 4-inch sewer line at the septic tank inlet.

7.2.7.3 All septic tank effluent must pass through the effluent filter. No by-pass capability may be designed into the effluent filter. A high-water alarm should be installed to signal that the filter has clogged and needs maintenance.

7.2.7.4 The effluent filter must be secured so that inadvertent movement does not take place during operation or maintenance. Filters must be readily accessible to the ground surface and the handle must extend to within 2 inches of the access riser lid to facilitate maintenance.

7.2.7.5 Openings developed by penetration, saw cut, or equivalent must be process controlled and all mold flash and penetration burrs removed.

7.2.7.6 The effluent filter material must be designed such that the filtering medium maintains structural integrity throughout the life of the device. The filter medium must not tear or otherwise distort so as to make the filter inoperable during normal operation. The entire filter must be constructed of proven corrosion resistant material for use in wastewater applications.

7.2.7.7 The effluent filter manufacturer must provide documentation that shows at least three years successful field-testing and operation or that the filter meets the design standard for effluent filters in ANSI/NSF Standard 46. The documentation must show the effluent filter has continuously lowered the Total Suspended Solids (TSS) by a minimum of 30 percent and that under normal use the filter is capable of obtaining a minimum of 3 years between maintenance intervals.

7.2.7.8 The effluent filter manufacturer must provide installation and maintenance instructions with each filter. The installer must follow the manufacturer's instructions when installing the filter and must use the manufacturer's recommendations for sizing and application. The installer must provide the owner of the system with a copy of the maintenance instructions.

7.2.7.9 The effluent filter manufacturer must certify to the reviewing authority that the filter meets the requirements of this standard.

7.2.8 A septic tank must provide an air space above the liquid level, which will be equal to or greater than 20 percent of its liquid capacity. Dose tanks do not need to meet the 20 percent air space requirement. Each compartment of the septic tank must be vented back to the inlet pipe.

7.2.9 Inspection ports measuring at least 8 inches in diameter must be provided above each inlet and outlet and marked with rebar. An access at least 1.75 square feet in size must be provided into each compartment. Each access must be extended to within 12 inches of the finished ground surface. An access of the effluent filter of a size large enough to maintain the filter must be provided and must be extended to the finished ground surface.

7.2.10 Sizing of septic tanks

7.2.10.1 Minimum capacities are:
A minimum acceptable size of septic tank is 1,000 gallons for any system. Two single compartment tanks may be connected in series to meet the capacity requirements. The reviewing authority may have additional maintenance requirements for tanks connected in series.

A. For residential flows:

1. For 1 to 3 bedrooms, the minimum size septic tank is 1,000 gallons.

2. For 4 to 5 bedrooms, the minimum size septic tank is 1,500 gallons.

3. For 6 to 7 bedrooms, the minimum size septic tank is 2,000 gallons.

4. For 8 or more bedrooms, the minimum size septic tank is 2,000 gallons plus 250 gallons for each bedroom greater than 7 bedrooms (i.e. 8 bedrooms requires a 2,250 gallon tank; 9 bedrooms requires a 2,500 gallon tank).

B. For non-residential flows of less than or equal to 1,500 gallons per day, the tank must have a capacity of at least 2.7 times the design flow.

C. For non-residential flows of greater than 1,500 gallons per day, the tank must have a minimum capacity equal to 2.25 times the average daily flow.

D. For a septic tank less than or equal to 5,000-gallon liquid capacity, depths greater than 78 inches must not be used in computing tank capacity.

E. For the septic tank greater than 5,000-gallon liquid capacity, the maximum liquid depth is determined by dividing the liquid length by a factor of 2.5.

F. Septic tank volume may be sized using nationally recognized plumbing codes, provided that there is adequate volume to store at least 3.5 times the estimated daily wastewater flow, and the sizing is approved by the reviewing authority.

7.2.10.2 The nominal length of the septic tank must be at least twice the width (or diameter) of the tank.

7.2.10.3 Dose tanks are excluded from these length, width, and depth requirements.

7.2.11 Grease traps

Establishments such as restaurants that produce grease exceeding the limits of residential strength wastewater must be provided with grease traps and meet the requirements of Section 5.4.

7.3 Construction

All tanks must be watertight. Tanks used for commercial facilities, multiple-user systems or public systems must be tested in place for watertightness. Watertightness testing for a concrete tank may be conducted using a water test or vacuum test. Watertightness testing for a fiberglass tank may be conducted using a water test, a vacuum test, or a pressure test.

7.3.1 Water testing must be conducted by sealing the outlets, filling the septic tank to its operational level, and allowing the tank to stand for at least 8 hours. If there is a measurable loss (2 inches or more), refill the tank and let stand for another 8 hours. If there is again a measurable loss, the tank must be rejected.

7.3.2 Vacuum testing must be conducted by sealing all inlets, outlets, and accesses, then introducing a vacuum of 4 inches of mercury. If the vacuum drops in the first 5 minutes, it must be brought back to 4 inches of mercury. If the septic tank fails to hold the vacuum at 4 inches of mercury for 5 minutes, the tank must be rejected.

7.3.3 For pressure testing a fiberglass tank, all inlets, outlets, and access ports must be sealed and adequately secured. The tank must be charged with 5 psig (3 psig for a 12-foot diameter tank). Allow tank pressure to stabilize. Disconnect the air supply. If there is any noticeable pressure drop in 1 hour, the tank must be rejected or repaired. Repeat the test after repair. Release air carefully through an appropriate valve mechanism.

7.4 Maintenance

Owners of septic systems should obtain septic tanks maintenance recommendations published by Montana State University Extension Service, which are available through Montana County Extension Service offices located in each county. Two of these publications are Septic Tank and Drainfield Operation and Maintenance and Septic System Inspection and Troubleshooting. Those who own the systems with siphons, pumps, or controls should carefully adhere to manufacturer’s recommendations for operation and maintenance and seek guidance from the county extension service.

CHAPTER 8

STANDARD ABSORPTION TRENCHES

8.1 General

The satisfactory operation of the wastewater treatment system is largely dependent upon proper site selection and the design and construction of absorption trenches.

8.2 Location

Absorption trenches must meet the location criteria in ARM Title 17, chapter 36, subchapter 3 or 9.

8.3 Design

8.3.1 Distribution pipe materials

8.3.1.1 Gravity-fed distribution lines must be fabricated from 4-inch diameter ASTM D-3034 PVC sewer pipe with perforations per ASTM D-2729.

8.3.1.2 Coiled, perforated-plastic pipe may not be used when installing absorption systems. Straight lengths of pipe must be used instead.

8.3.1.3 Pipe used for pressure-dosed distribution lines must meet ASTM D1785 or ASTM D2241. Fittings used in the absorption field must be compatible with the materials used in the distribution lines. Pressure-rated fittings must be used for pressure-dosed piping.

8.3.2 Trench design

8.3.2.1 The minimum area in any absorption trench system must be based upon the flow as determined in Chapter 5 and sized by the soil type, and percolation rate if percolation testing is required by the reviewing authority, whichever results in a larger absorption system, in accordance with Tables 9-1 and 9-2. Percolation tests may be required by the reviewing authority when the soils are variable or other conditions create the need to verify trench sizing.

8.3.2.2 An area that can be used as a replacement area for the original absorption trench system must be designated. Interim use of the area must be compatible with future absorption system use. The replacement area must be separate from the primary area and must not be interlaced within the primary area. If interlaced, minimum separation must be 14 feet between primary lines.

8.3.2.3 Gravity-fed and gravity-dosed absorption trenches must be separated by at least 5 feet between trench walls. Pressure-dosed absorption trenches must be separated by at least 4 feet between trench walls.

8.3.2.4 Gravity-fed and gravity-dosed absorption trenches must be at least 18 inches wide. Systems utilizing pressure distribution may have absorption trenches 36 inches wide. For the purposes of sizing, gravity-fed and gravity-dosed trenches must not be considered more than 24 inches wide.

8.3.2.5 The bottom of the absorption trenches must be at least 12 inches and no more than 36 inches below the natural ground surface. There must be a minimum of 12 inches of soil or fill material above the drain rock. When the trench is less than 24 inches below ground, a cap above the natural ground surface is required. The cap must be tapered from the edge of the outermost trench wall with a 3 horizontal to 1 vertical or flatter slope. The cap must be sloped to provide positive drainage away from the center of the absorption system.

8.3.2.6 Gravity-fed absorption trenches may not exceed 100 feet in length from where effluent is first applied to the soil.

8.3.2.7 Gravity-fed absorption field distribution lines must be 4 inches in diameter.

8.4 Application rates for sizing of the absorption system

8.4.1 Application rates and absorption system length can be determined by using Table 8-1 for residential systems and Table 8-2 for nonresidential facilities or the formula in section 8.4.2. The residential tables have been calculated for a three bedroom residence, for more or less bedrooms (use the formula in Section 8.4.2). The commercial tables have been calculated for 100 gallons per day (gpd) flow rate, for flows other than 100 gpd, use the formula in Section 8.4.2. Comparison of the soil profile report, percolation rate, and USDA soils report will be used to select the applicable square footage for an absorption system. The application rate (gpd/ft^2) is the maximum application rate for each soil type listed in Table 8-1 and Table 8-2.

8.4.2 For determining absorption system sizing, the following formula may be used: Wastewater Flow from Chapter 5 (gpd) divided by the application rate in Table 8-1 or Table 8-2(gpd/ ft^2) = Absorption system length (ft^2) or expressed as a mathematical formula:

$$\frac{\text{gpd}}{\text{gpd/ft}^2} = \text{ft}^2$$

TABLE 8-1 (Residential)

Texture	Square feet for three bedroom (ft^2)	Estimated Perc rate (min/in)	Application rate (gpd/ft^2)
Gravelly sand or very coarse sands	375	< 3 (a)	0.8(a)
Loamy sand, coarse sand	375	3 - < 6	0.8
Medium sand, sandy loam	500	6 - <10	0.6
Fine sandy loam, loam, silt loam	600	10 - <16	0.5
Very fine sand, sandy clay loam	750	16 - <31	0.4
Clay loam, silty clay loam	1000	31 - <51	0.3
Sandy clay, clay, or silty clay	1500(b)(c)	51 - <121	0.2
Clays, silts, silty clays (soil is reported throughout the soil profile) (USE EVTA BED)	2000(d)	≥ 121	0.15
Clays or silts, pan evaporation rates do not allow for EVTA use		≥ 121	NP

(a) If the soil for 3 feet below the infiltrative surface contains more than 15 percent gravel or there is less than 6 feet separation between the bottom of the trench and a limiting layer, the trench must be sand-lined and pressured-dosed or other treatment provided as approved by the reviewing authority.
(b) Pressure distribution will be required if more than 500 lineal feet (or 1000 square feet) of distribution line is needed.
(c) Comparison of soils profile report, percolation rate, and USDA soils report will be used to select applicable square footage.
(d) Square footage is increased because the trench sidewall is not available in EVTA bed systems.
NP – Not permitted

TABLE 8-2 (Nonresidential Facilities)

Texture	Square feet for 100 gpd (ft^2)	Estimated Perc rate (min/in)	Application rate (gpd/ft^2)
Gravelly sand or very coarse sands	125	< 3 (a)	0.8 (a)
Loamy sand, coarse sand	125	3 - < 6	0.8
Medium sand, sandy loam	167	6 - <10	0.6
Fine sandy loam, loam, silt loams	200	10 - <16	0.5
Very fine sand, sandy clay loam	250	16 -<31	0.4
Clay loam, silty clay loam	333	31 - <51	0.3
Sandy clay, clay or silty clay	500(b)(c)	51 - < 121	0.2
Clays, silts, silty clays (soil is reported throughout the soil profile) (USE EVTA BED)	667 (d)	≥ 121	0.15
Clays or silts, pan evaporation rates do not allow for EVTA use	NP	≥ 121	NP

(a) If the soil for 3 feet below the infiltrative surface contains more than 15 percent gravel or there is less than 6 feet separation between the bottom of the trench and a limiting layer, the trench must be sand-lined and pressured-dosed or other treatment provided as approved by the reviewing authority.
(b) Pressure distribution will be required if more than 500 lineal feet (or 1,000 square feet) of distribution line is needed.

(c) Comparison of soils profile report, percolation rate, and USDA soils report will be used to select applicable square footage.
(d) Square footage is increased because the trench sidewall is not available in EVTA bed systems.
NP – Not permitted

8.5 Slope

Gravity-fed and gravity-dosed absorption field distribution lines and trenches must be level. Pressure-dosed distribution lines in a sand filter or absorption system must be level, unless a hydraulic analysis indicates uniform distribution of effluent will occur with a sloped line.

8.6 Material

The material used to cover the top of the drain rock must be synthetic drainage fabric or several (two to four) layers of untreated building paper. A 2-inch layer of straw may be substituted when these materials are unavailable. Nonporous plastic or treated building paper may not be used.

8.7 Distribution boxes

If a distribution box is used, it must:

A. Be set level and bedded to prevent settling.
B. Use some flow control or baffling device to ensure equal distribution of effluent.
C. Be water tested for equal distribution.
D. Have each outlet serving an equal length of absorption trench.
E. If constructed using concrete, the concrete must meet the same requirements as concrete for septic tanks in 7.2.2. Minimum wall, floor, and lid thickness for concrete distribution boxes must be 2 inches. Reinforcement is not required for concrete distribution boxes.
F. Have an access for inspection provided either through a riser or be marked with iron or a suitable, durable marker.

8.8 Construction

8.8.1 Pipes leading into and out of septic tanks must have solid walls and have a minimum downward slope of 1/8 inch per foot. Schedule 40 pipe must be used leading into and out of the septic tank in the area of backfill around the tank for a minimum length of at least 10 feet.

8.8.2 A manifold must be installed between the septic tank and the absorption trenches. The manifold must be of watertight construction. Distribution boxes may be used in gravity systems in lieu of manifolds. Manifolds must be set level and arranged so that effluent is distributed to an equal length of distribution pipe on both sides of the junction of the inlet pipe to the manifold.

8.8.3 When the trenches have been excavated, the sides and bottom must be raked to scarify any smeared soil surfaces. Construction equipment not needed to construct the system should be kept off the area to be utilized for the absorption trench system to prevent undesirable compaction of the soils. Construction must not be initiated when the soil moisture content is high.

Note: If a sample of soil within the working depth can be easily rolled into the shape of a wire or cast, the soil moisture content is too high for construction purposes.

8.8.4 At least 6 inches of drain rock must be placed in the bottom of the trench.

8.8.5 The distribution pipe must be covered with at least 2 inches of drain rock.

8.8.6 The ends of the distribution pipes must be capped or plugged; when they are at equal elevations, they should be connected.

8.8.7 Leaching chambers may be used in place of distribution pipe and drain rock in accordance with Chapter 13.

CHAPTER 9

DOSING SYSTEM

9.1 Dosing includes both gravity dosing and pressure distribution). Pressure distribution should be utilized whenever practical and must be utilized when the design wastewater flow requires more than 500 lineal feet or 1000 square feet of distribution lines. The effective length of the absorption area is the actual length of the trench, which cannot exceed the length of the pipe by more than one-half the orifice spacing.

9.2 Dosing may be accomplished with either pumps or siphons. For gravity-dosed systems, the volume of each dose must be at least equal to 75 percent of the internal volume of the distribution lines being dosed.

9.3 The dose volume of a pressure-distribution system must be equal to the drained volume of the discharge pipe (pipe leading from the septic tank or dose tank to the distribution lines) and manifold, plus a volume that should be 5 to 10 times the net volume of the distribution pipe. Where the system is designed to operate on a timer, more frequent, smaller doses may be used. The minimum dose volume must still be equal to the drained volume of the discharge pipe and manifold, plus a volume equal to at least two times the distribution pipe volume. Where timers are used, additional controls are necessary to prevent pump operation at low-water level.

9.4 The pressure-distribution pipe must be PVC and all fittings must be pressure rated and at least Class 160 PVC pipe. The pipe must have a single row of orifices 1/8-inch diameter or larger in a straight line. Design must include orifices to allow for drainage of the pipe and to allow air to be expelled from the pipe. Maximum orifice spacing must be 5 feet. The size of the dosing pumps and siphons must be selected to provide a minimum pressure of 1 psi (2.3 feet of head) at the end of each distribution line. For orifices smaller than 3/16-inch, the minimum pressure must be 2.16 psi (5 feet of head) at the end of each distribution line.

9.5 The duration of each discharge may not exceed 15 minutes to promote uniform distribution.

9.6 A hydraulic analysis demonstrating uniform distribution must be provided for all pressure-dosed systems. The analysis must show no greater than 10 percent variation in distribution of dose across the entire absorption system or sand filter/sand mound or hydraulic zone of absorption system or sand filter/sand mound.

9.7 Cleanouts must be provided at the end of every lateral. The cleanouts must be within 6 inches of finished grade and should be made with either a long-sweep elbow or two 45-degree bends. A design engineer may specify the use of capped ends that are replaced after flushing if, in his opinion, this is a more feasible option than long sweep cleanouts. A metal location marker or plastic valve cover must be provided for each cleanout.

9.8 Dosing tanks

9.8.1 The reserve storage volume of the dosing system must be at least equivalent to 25 percent of the design flow. If a duplex pump station is used, the reserve volume of the dosing system may be reduced. The reserve storage volume is computed from the high-level alarm. The tank must also include adequate liquid capacity for pump submergence and the dose volume. The required volume of the dosing tank must not be considered as any portion of the required volume of the septic tank. The dosing tank must be separated from the septic tank by an air gap to eliminate the possibility of siphoning from the septic tank. Dosing tanks must be provided with access ports sufficiently large to maintain the tank and pumps. Pumps, valves, and other apparatus requiring maintenance must be accessible from the surface without entering the tank or be located in a dry tank adjacent to the wet chamber.

9.8.2 Dosing tanks must meet the material requirements for septic tanks and must be watertight. Dosing tanks utilizing pumps must meet the requirements of Section 6.6.3.

9.8.3 High-water alarms must be provided for all dosing chambers that utilize pumps.

Dosed systems using a siphon should have a dose counter installed to check for continued function of the siphon.

9.9 Pressure distribution systems must be field-tested to verify uniform distribution, which is typically done by a test showing approximately equal squirt height.

CHAPTER 10

DEEP ABSORPTION TRENCHES

10.1 Deep absorption trenches may be used to break through a less permeable soil layer and allow effluent to infiltrate a deeper and more permeable soil. The bottom of the trench must not be more than 5 feet below natural ground surface.

10.2 The site evaluation must include soil profile descriptions of at least two soil observation pits excavated to a minimum depth of 4 feet below the proposed trench bottom. All separation distances in ARM Title 17, chapter 36, subchapter 3 or 9 must be maintained. Monitoring to establish depth to seasonally high ground water may be required where the reviewing authority has reason to believe that ground water is within 6 feet of the bottom of the absorption trench.

10.3 Deep absorption trenches must be constructed at least 1 foot into suitable soil.

10.4 The bottom (invert) of the distribution pipe for a deep absorption trench must be installed no deeper than 30 inches from the ground surface. The deep trench must be dug 1 foot into the acceptable soil and backfilled with a medium sand (with no more than 3 percent finer than the No. 100 sieve), drain rock, or other approved material to the level of a standard absorption trench. The system must be sized based on the lesser application rate for the soil infiltrative surface or the backfill sand.

10.5 Leaching chambers may be used in place of distribution pipe and drain rock in accordance with Chapter 13.

CHAPTER 11

AT-GRADE ABSORPTION TRENCHES

11.1 General

At-grade systems may be used only for residential strength wastewater and where the design flow does not exceed 500 gallons per day. At-grade systems must not be installed on land with a slope greater than 6 percent or where the percolation rate is slower than 40 minutes per inch.

11.2 Effective area

11.2.1 The effective area is that area which is available to accept effluent. The effective length of the absorption area is the actual length of the trench, which cannot exceed the length of the pipe by more than one-half the orifice spacing. The effective width is the actual width of the washed rock below the distribution pipe, not to exceed 3 feet for each pipe.

11.2.2 The effective area must be 1.5 times the area required for a standard absorption trench, as described in Table 9-1. Percolation tests must be conducted at a depth of not more than 12 inches below ground surface.

11.3 Pressure distribution is required for at-grade systems.

11.4 Construction

11.4.1 The ground surface where the system is to be placed must be plowed, scarified, or trenched less than 12 inches in depth. Trenching is preferred to plowing or scarifying to prevent horizontal migration of the effluent. There must be at least four feet of natural soil between the scarified layer and groundwater or other limiting layer. The absorption "trench" is constructed by placing drain rock on the scarified ground, with a minimum width of 24 inches at the bottom of the distribution pipe. A minimum of 6 inches of drain rock must be placed under the distribution pipe and a minimum of 2 inches of drain rock must be placed over the distribution pipe. Leaching chambers may be used in place of distribution pipe and drain rock in accordance with Chapter 13.

11.4.2 An appropriate geotextile fabric must be placed over the drain rock and covered with approximately 1 foot of soil.

11.4.3 The fill over the distribution pipe must extend on all sides at least 5 feet beyond the edge of the aggregate below the distribution pipe.

11.4.4 Construction equipment which would cause undesirable compaction of the soils must not be moved across the plowed surface or the effluent disposal area. Construction and/or plowing must not be initiated when the soil moisture content is high.

Note: If a sample of soil within the working depth can be easily rolled into the shape of a wire or cast, the soil moisture content is too high for construction purposes.

CHAPTER 12

SAND-LINED ABSORPTION TRENCHES

12.1 General

Sand-lined absorption trenches are used for rapid permeability situations. The trench below the drain rock is lined with sand to provide additional treatment.

12.2 Design

Trenches must be lined with a minimum of 12 inches of fine to medium sand or loamy sand below the constructed absorption system. For rapid permeability situations, the system is to be sized in accordance with Chapter 9 for the soils with percolation rates faster than 3 minutes per inch. For slow permeability situations, the system is to be sized according to the percolation rate of the soils below the trench in accordance with Chapter 9. Where systems are placed in soils with a percolation rate faster than 3 minutes per inch and the depth to seasonally high ground water is less than 6 feet from the bottom of the drain rock, the system must be designed using pressure distribution. If pressure distribution is not used, the side walls of the trench must also be sand-lined a minimum of 6 inches to a point 2 inches above the pipe. As an alternative to placing sand on the side walls of the trench, a 24-inch wide trench with gravity distribution may be constructed with the sand placed such that the elevation of the sand at the center of the trench is at least 6 inches lower than the sand at the edge of the trench (i.e., form a V-ditch with the sand). The sand at the center of the trench must still be at least 12 inches in depth.

12.3 Construction

Where the side walls of the trench must be sand-lined, the trenches must be a minimum of 36 inches wide. Detailed construction specifications will be required showing how side walls will be lined. Sand must not be allowed to enter into the washed gravel zone during construction.

12.4 Leaching chambers may be used in place of distribution pipe and drain rock in accordance with Chapter 13.

CHAPTER 13

GRAVELLESS ABSORPTION TRENCHES

13.1 General

Gravelless systems include infiltration or leaching chambers. Absorption trenches for these systems must meet the same requirements as a standard absorption trench, except where specifically modified in this chapter.

13.2 Leaching chambers

13.2.1 Leaching chambers are chambers with an open bottom structurally designed to carry the earth loading.

13.2.2 Leaching chambers must consist of high-density polyolefin or other approved material and be structurally sound for their intended use. Products must maintain at least 90 percent of their original height (vertical deflection shall not exceed 10 percent of original product height) when installed according to manufacturer's installation guidelines and subjected to a 4,000-pound axle load. Vertical deflection is the combined product height deflection due to installation (soil dead load) and the 4,000-pound axle load measured when the tire is directly over the product.

13.2.3 The maximum trench width for chamber is 36 inches. If the trench width exceeds 24 inches, pressure distribution will be required.

13.2.4 The total bottom area of the chamber will be used to calculate the infiltration area. The absorption system size in square footage per Chapter 8 may be reduced in size by 25 percent when using infiltration or leaching chambers. Chambers that are 15 inches in width will be equal to a 18-inch trench width, a 22-inch width chamber will be equal to a 24 inch trench width, and 34-inch width chambers will be equal to a 36 inch width trench for calculating absorption system sizing. The size of the replacement absorption system must be large enough to accommodate a standard absorption system, even though this full area will not be used as part of the primary system.

13.2.5 Chambers may be used in lieu of pipe and drain rock for standard absorption trenches, deep absorption trenches, at-grade absorption trenches, sand-lined absorption trenches, intermittent sand filters, recirculating sand filters, evapotranspiration systems, and evapotranspiration absorption systems.

CHAPTER 14

ELEVATED SAND MOUNDS

14.1 Location

14.1.1 Separation distances must be measured from the outside of the mound where the topsoil fill meets the natural ground surface or, if the design uses a lesser slope for landscaping purposes, where the toe of the mound would be if the 3:1 slope specified in Section 14.2.7 were used.

14.1.2 Elevated sand mounds must be constructed only upon undisturbed, naturally occurring soils.

14.1.3 Elevated sand mounds may not be installed on land with a slope greater than 12 percent for soils with a percolation rate faster than 30 minutes per inch nor installed on land with a slope greater than 6 percent on soils with a percolation rate between 30 and 120 minutes per inch. Where trenches are used, the trenches must be installed with the long dimension parallel to the land contour.

14.2 Design

14.2.1 *The Wisconsin Mound Soil Absorption System Siting, Design, and Construction Manual*, January 2000, is recommended as a procedural guideline in the design of elevated sand mounds. The requirements of this circular may be different from those in this reference document, and the requirements of this circular will govern in those cases. The wastewater strength discharged to the mound must not exceed residential strength wastewater.

14.2.2 There must be a minimum total depth of 21 inches of sand fill above the natural soil surface and 12 inches of sand fill between the bottom of the trench or bed and the natural soil surface. Sand must be washed free of silts and clays. The in-place fill material must meet one of the following specifications:

A. STM C-33 for fine aggregate, with a maximum of 2 percent passing the No. 100 sieve, or

B. Fit within the following particle size distribution:

Sieve	Particle Size (mm)	Percent Passing
3/8 in	9.50	100
No. 4	4.75	95 to 100
No. 8	2.36	80 to 100
No. 16	1.18	45 to 85
No. 30	0.60	20 to 60
No. 50	0.30	10 to 30
No. 100	0.15	0 to 2

C. Have an effective size (D10) of 0.15 mm to 0.30 mm with a Uniformity Coefficient (D60/D10) of 4 to 6, with a maximum of 3 percent passing the No. 100 sieve.

14.2.3 Drain rock must be washed and range in size from ¾ to 2-1/2 inches. A design engineer may specify a specific size of drain rock if evidence is provided demonstrating the specific size will function equal to the washed rock that ranges in size from ¾ to 2-1/2 inches. Drain rock must be at least 9 inches deep and must be covered with filter fabric.

14.2.4 The minimum spacing between trenches must be 4 feet, and the trench width must be 3 feet. Where beds are used, the distribution pipes must be installed parallel to the land contour, with spacing between pipes of at least 3 feet and no more than 5 feet. If using gravelless chambers, the minimum spacing must be 4 feet between the center of each chamber.

14.2.5 The required bottom area of the trench or trenches or gravel area for beds must be based upon flows and application rates as determined in Chapter 5 and Chapter 9, with an application rate of 1.0 gallons/day/square foot. A maximum flow per orifice should not create a saturated flow for the depth of the sand fill.

14.2.6 The length of the absorption trenches should be at least three times the width of the mound.

14.2.7 For soils with percolation rates between 61 and 120 minutes per inch with slopes of 1 to 2 percent, the land area 25 feet on all sides of the elevated sand mound must not be disturbed. A mound system that is constructed on slopes of 3 to 12 percent the effluent dispersal area is considered 50 feet on the down slope side, and the soil in this area may not be removed or disturbed except as specified. For soils with percolation rates faster than 61 minutes per inch, the land area 25 feet down slope of the elevated sand mound may not be removed or disturbed except as specified.

14.2.8 The area of sand fill must be sufficient to extend 2 feet beyond the edges of the required absorption area before the sides are shaped to a 3 horizontal to 1 vertical or lesser slope. On sloping sites, the down slope setback must be based on the soil percolation rate (see 14.2.7).

14.2.9 The mound must be covered with a minimum of 12 inches (at the center of the mound) and 6 inches (at the edge of the mound) of a suitable medium, such as sandy loam, loamy sand or silt loam, to provide drainage and aeration.

14.3 Construction

14.3.1 The ground surface where a mound is to be placed must be plowed or scarified, or the sand mound may be keyed into the natural ground 4 inches to 8 inches by removing a portion of the topsoil. When mounds are keyed in, the removed soil must be replaced with the same sand as required for the rest of the mound, and this sand will not count as part of the required 21 inches of sand in the mound as described in section 14.2.2.

14.3.2 Construction equipment that would cause undesirable compaction of the soils must not be moved across the plowed surface or the effluent disposal area. However, after placement of a minimum of 6 inches of sand fill over the plowed area, construction equipment may be driven over the protected surface to expedite construction. Construction and/or plowing must not be initiated when the soil moisture content is high.

Note: If a sample of soil within the working depth can be easily rolled into the shape of a wire or cast, the soil moisture content is too high for construction purposes.

14.3.3 Above-ground vegetation must be closely cut and removed from the ground surface throughout the area to be utilized for the placement of the fill material. The fill that is the portion of the 3 to 1 side slope may have trees left in place if, in the opinion of the designer, the trees will enhance the nutrient uptake of the mound. Prior to plowing or scarifying, the dosing-pump discharge line from the pump chamber to the point of connection with the distribution-piping header must be installed. The area must then be plowed, scarified, or keyed in to a depth of 4 to 8 inches, parallel to the land contour, with the plow throwing the soil up slope to provide a proper interface between the fill and natural soils. Tree stumps should be cut flush with the surface of the ground, and roots should not be pulled.

14.3.4 The area surrounding the elevated sand mound must be graded to provide for diversion of surface runoff waters.

14.3.5 Construction should be initiated immediately after preparation of the soil interface by placing all of the sand fill needed for the mound (to the top of the trench) to a minimum depth of 21 inches above the plowed surface. This depth will permit excavation of trenches to accommodate the 9 inches of drain rock necessary for the distribution piping. After hand leveling of the absorption area, the drain rock should be placed into the trench and hand leveled. An observation port into the gravel is recommended but not required. Filter fabric must be placed over the drain rock to separate the drain rock from the soil cover. After installation of the distribution system, the entire mound should be covered with 6 inches of a finer textured soil material, such as sand loam to loam. A 4- to 6- inch layer of topsoil should then be added. The entire mound should be sloped to drain, either by providing a crown at the center or a uniform slope across the mound, with a minimum slope of 1 percent in either case. The entire mound must be seeded, sodded, or otherwise provided with shallow-rooted vegetative cover to ensure stability of the installation.

14.3.6 The installation of the mound system must be inspected by the designer, who must certify that the system has been installed according to the approved design. As-built plans may be required by the reviewing authority prior to final approval of the system.

14.4 Dosing system design

Pressure distribution is required for the elevated sand mound system.

14.5 Gravelless chambers constructed in accordance with the requirements of Chapter 13 may be used in lieu of a standard absorption trench. No reduction in absorption system sizing will be allowed for chambers in this application.

CHAPTER 15

INTERMITTENT SAND FILTERS

15.1 General

The design criteria must include, but not necessarily be limited to, the type of usage, primary treatment, filter media, filtration rate, and dosage rate. The wastewater strength discharged to the filter must not exceed residential strength wastewater. Sand filters must discharge to a subsurface absorption system. The absorption system used for final disposal may be downsized by 50 percent, as determined by Chapter 8, for soils with percolation rates between 3 and 60 minutes per inch. The absorption system used for final disposal may be downsized by 25 percent, as determined by Chapter 8, for soils with percolation rates between 60 and 120 minutes per inch.

15.2 Design

The minimum area in any subsurface sand filter must be based upon a flow as determined in Chapter 5.

15.2.1 The application rate for intermittent sand filters may not exceed 1.2 gal/day/ft^2.

15.2.2 A minimum of one collection line must be provided. The upper end of the collection line must be provided with a 90-degree elbow turned up, a pipe to the surface of the filter, and a removable cap. The collection line may be level. The bottom of the filter may be flat or sloped to the collection line(s).

15.2.3 Distribution lines must be level and must be horizontally spaced a maximum of 3 feet apart, center to center. Orifices must be placed such that that there is at least one orifice for each 4 square feet of sand surface area. All intermittent sand filter dosing must be controlled by a programmable timer. The minimum depth of filter media must be 24 inches. A watertight, 30-mil PVC liner (or equivalent) must be used to line the sand filter.

15.2.4 There must be a minimum of 2 inches of sand fill between the soil surface and/or any projecting rocks and the liner.

15.2.5 Drain rock must be placed in the bottom of the filter to provide a minimum depth of 8 inches in all places and to provide a minimum of 4 inches of material over the top of the collection lines. The drain rock must be covered with a 3-inch thick layer of ¼ inch to 1 inch washed gravel.

Gravel measuring ¼ inch to 1 inch in diameter must meet the following gradation:

Sieve	Particle Size (mm)	Percent Passing
1 inch	25	100
¾ inch	19	50 to 100
3/8 inch	9.5	30 to 80
No.4	4.75	0 to 20
No. 8	2.36	0 to 2
No. 16	1.18	0 to 1

Drain rock must meet the requirements for a standard absorption system, except it must be a minimum of 1 inch in diameter to prevent clogging.

15.2.6 A layer of ¼-inch to 1-inch washed gravel must be placed over the sand media, with at least 3 inches placed over the distribution lines and 3 inches placed under the distribution lines.

15.2.7 The filter must be covered with 6 inches (at the edges) to 8 inches (at the center) of a suitable medium, such as sand loam or loamy sand, to provide drainage and aeration. The material must be seeded, sodded, or otherwise provided with shallow-rooted vegetative cover to ensure stability of the installation.

15.2.8 Monitoring pipes to detect filter clogging must be installed. A means for sampling effluent quality must be provided.

15.3 Uniform pressure distribution must be provided for all sand filters in accordance with Chapter 9 except for Section 9.3.

15.4 The dose volume must not exceed 0.25 gallons per dose per orifice. The dose frequency must not exceed 1 dose per hour per zone. The dose tank must include a minimum surge volume of one-half the daily flow for individual or shared systems. For multiple-user and public systems, the applicant must demonstrate that a smaller surge volume is adequate. The surge volume is the liquid storage capacity between the "timer-on" float and the "timer-override" float. The "timer-override" float and the "high-water alarm" float may be combined. Note that the surge volume defined here is not the same as the reserve storage volume defined in Chapter 9.

15.5 Materials

15.5.1 The filter media must be washed and free of clay or silt and meet the following criteria in place.

Sieve	Particle Size (mm)	Percent Passing
3/8 in	9.50	100
No. 4	4.75	95 to 100
No. 8	2.36	80 to 100
No. 16	1.18	45 to 85
No. 30	0.60	15 to 60
No. 50	0.30	3 to 10
No. 100	0.15	0 to 2

15.5.2 The material used to cover the top of the sand filter must be separated from the filter by a synthetic drainage fabric.

15.5.3 If the system is intended to remove nitrogen, a complete description of the nitrification and dentrification processes must be provided in detail, including the unit where it occurs, carbon source, feed rates, loading rates, pumps, controls, and other mechanisms necessary.

15.5.4 A detailed set of plans and specifications and an operation and maintenance manual are required. The operation and maintenance plan must meet the requirements in Appendix D.

15.5.5 Gravelless chambers constructed in accordance with the requirements of Chapter 13 may be used in lieu of a standard absorption trench. No reduction in absorption system sizing will be allowed for chambers in this application. The use of chambers will not constitute any additional reduction beyond that listed in 15.1.

CHAPTER 16

RECIRCULATING SAND FILTERS

16.1 General

The design criteria must include, but not necessarily be limited to, the type of usage, primary treatment, filter media, filtration rate, and dosage rate. The wastewater strength discharged to the sand filter must not exceed residential strength wastewater. Sand filters must discharge to a subsurface absorption system. The absorption system used for final disposal may be downsized by 50 percent, as determined by Chapter 8, for soils with percolation rates between 3 and 60 minutes per inch. The absorption system used for final disposal may be downsized by 25 percent as approved by the reviewing authority, as determined by Chapter 8, for soils with percolation rates between 60 and 120 minutes per inch.

16.2 Design

16.2.1 A watertight, 30-mil PVC liner (or equivalent) must be used to line the sand filter. There must be a minimum of 2 inches of sand fill between the soil surface and/or any projecting rocks and the liner

16.2.2 Drain rock must be placed in the bottom of the filter, providing a minimum depth of 6 inches in all places and providing a minimum of 2 inches of material over the top of the collection lines. The drain rock must be covered with a 3-inch layer of 1/4-inch to 1-inch washed gravel meeting the gradation chart in 15.2.5. Drain rock for the under-drain lines must meet the requirements for a standard absorption system, except it must be a minimum of 1'' in diameter to prevent clogging. The drain rock at the bottom may be replaced with 1/8-inch to 3/8-inch washed gravel, except for 6 inches around the collection pipe.

16.2.3 The depth of filter media must be at least 24 inches. The media must have a maximum particle size of 3/8 inch, and an Effective Size between 1.5 and 2.5 mm with a Uniformity Coefficient of 2 or less, with less than 2 percent passing No. 30 sieve and less than 2 percent passing No. 50 sieve. Filter media measuring 1/8-inch to 3/8-inches in size must be washed and must meet the following gradation.

Sieve	**Particle Size (mm)**	**Percent Passing**
1/2 in	12.5	100
3/8 in	9.50	95 to 100
No. 4	4.75	0 to 30
No. 8	2.36	0 to 15
No. 100	15	0 to 2

16.2.4 The filter media must be covered with a layer of ¼-inch to 1½-inch washed gravel at least 6 inches thick. The distribution pipes must be installed in the center of this layer, and all parts of the distribution system must drain between cycles.

16.2.5 For sizing the filter, the application rate must not exceed 5 gallons per day per square foot of filter area. This must be computed by dividing the effluent flow rate (not considering the amount of recirculation) by the area (in square feet) of the filter.

16.2.6 The liquid capacity of the recirculation tank must be at least 1.5 times the daily design wastewater flow. The recirculation tank must meet the same material and construction specifications as a septic tank. The minimum liquid level in the recirculation tank must be at least 80 percent of the daily flow at all times during the 24-hour daily cycle. The reviewing authority may require systems with large surge flows to have recirculation tanks sized based on the estimated or actual surge flow volume.

16.2.7 The filter-effluent line passing through the recirculation tank must be provided with a control device that directs the flow of the filter effluent. The filter effluent will be returned to the recirculation tank for recycling or be discharged to the subsurface absorption system, depending upon the liquid level in the recirculation tank. The recirculation pump(s) must be located at the opposite end of the recirculation tank from the filter return line and the tank inlet(s).

16.2.8 The system must be designed with a minimum recirculation ratio of not less than four. Each orifice must be dosed at least every 30 minutes, and the maximum dose volume must be 2 gallons per orifice per dose. All recirculating sand-filter dosing must be controlled with a programmable timer.

16.2.9 A minimum of one collection line must be provided. The upper end of the collection line must be provided with a 90-degree elbow turned up, a pipe to the surface of the filter, and a removable cap. The collection line may be flat. The bottom of the filter may be flat or sloped to the collection line(s).

16.2.10 Distribution lines must be level and must be horizontally spaced a maximum of 3 feet apart, center to center. Orifices must be placed such that there is at least one orifice for each 4 square feet of filter media surface area.

16.2.11 The effluent must be discharged in such a manner as to provide uniform distribution in accordance with Chapter 9 except for Section 9.3.

16.2.12 The distribution line must be designed to be protected from freezing. The plans and engineering report will specify how this is accomplished.

16.2.13 Topsoil or other oxygen limiting materials must not be placed over the filter.

16.2.14 If the recirculation sand filter system is intended to remove nitrogen, a complete description of the nitrification and denitrification processes must be provided in detail, including the unit where it occurs, carbon source, feed rates, loading rates, pumps, controls, and other mechanisms necessary.

16.2.15 A detailed set of plans and specifications and an operation and maintenance manual are required. The operation and maintenance plan must meet the requirements in Appendix D.

16.2.16 Gravelless chambers constructed in accordance with the requirements of Chapter 13 may be used in lieu of a standard absorption trench. No reduction in absorption system sizing will be allowed for chambers in this application. The use of chambers will not constitute any additional reduction beyond that listed in 16.1.

CHAPTER 17

RECIRCULATING TRICKLING FILTERS

17.1 General

These systems utilize aerobic, attached-growth treatment processes to biologically oxidize organic material and convert ammonia to nitrate (nitrification). A trickling filter consists of a bed of highly permeable medium to which a bio-film adheres. Wastewater is applied to the top of the bed and trickles through the media. Microorganisms in the bio-film degrade organic material and may also nitrify the wastewater. An under-drain system collects the treated wastewater and any sloughed solids and transports it to a settling tank from which it is recirculated back through the trickling filter. The absorption system used for final disposal may be downsized by 50 percent, as determined by Chapter 8, for soils with percolation rates between 3 and 60 minutes per inch. The absorption system used for final disposal may be downsized by 25 percent as approved by the reviewing authority, as determined by Chapter 8, for soils with percolation rates between 60 and 120 minutes per inch.

17.2 Design

The design criteria must include, but not necessarily be limited to, primary treatment, filter size, filter media, organic loading, hydraulic loading, dosing rate, and recirculation rate. A discussion of the treatment by the trickling filter must be provided.

17.2.1 Recirculating trickling filter systems must have a means of primary and secondary settling. Additional components such as pump chambers, pumps, controls, recirculation valves, etc. may be used as required.

17.2.2 Filter medium must be resistant to spalling or flaking, and must be relatively insoluble in wastewater. The type, size, depth, volume, and clogging potential of the medium used must be based on published criteria and proven through monitoring and testing (see Section 17.2.8).

17.2.3 The vessel containing the media must be watertight and corrosion resistant.

17.2.4 Waste effluent must be distributed uniformly across the design surface area of the filter.

17.2.5 The means of aerating the recirculation trickling filter must be described. If the means of aeration does not require any mechanical equipment, the system may be considered a passive nutrient reduction system if nutrient reduction is proven through monitoring and testing. If the means of aeration requires mechanical equipment, the system may be considered a nonpassive nutrient reduction system if nutrient reduction is proven through monitoring and testing.

17.2.6 The method of recirculation and recirculation rate must be discussed and justified.

17.2.7 All recirculating trickling systems must operate in a manner such that if a component of the system fails and treatment diminishes or ceases, untreated effluent will not be discharged to the absorption system. Systems must be equipped with adequate alarms.

17.2.8 If the recirculation trickling filter system is intended to remove nitrogen, a complete description of the nitrification and denitrification processes must be provided in detail, including the unit where it occurs, carbon source, feed rates, loading rates, pumps, controls, and other mechanisms necessary.

17.2.9 The Department will consider the complexity and maintenance required of the system, the stability of the processes, and the monitoring data in determining the adequacy, level of maintenance, and monitoring frequency of the system.

17.2.10 Gravelless chambers constructed in accordance with the requirements of Chapter 13 may be used in lieu of a standard absorption trench. No reduction in absorption system sizing will be allowed for chambers in this application. The use of chambers will not constitute any additional reduction beyond that listed in 17.1.

17.2.11 A detailed set of plans and specifications and an operation and maintenance manual are required. The operation and maintenance plan must meet the requirements in Appendix D.

CHAPTER 18

EVAPOTRANSPIRATION ABSORPTION SYSTEMS

18.1 Evapotranspiration absorption (ETA) systems must meet all minimum separation distances as stated in ARM Title 17, chapter 36, subchapter 3 or 9. Distances must be measured from the edge of the system. ETA systems must not be installed on land with a slope greater than 6 percent.

18.2 The material in the ETA system must be at least 24-inches deep below the laterals and must be washed coarse sand or drain rock. Testing must be provided to document the void ratio used. In this application, drain rock larger than the orifice size up to a maximum of 6 inches in diameter may be used.

18.2.1 ETA systems must utilize pressure distribution design. The beds must be installed with the long dimension parallel to the land contour. A minimum of one lateral per ten feet of bed width is required.

18.2.2 The volume of the ETA system must be based upon the pan evaporation, average precipitation for a 10-year period, and soils information from the site. The design must show that total water lost through evaporation and absorption equals or exceeds the total water gained through precipitation and effluent discharge. Due to lack of pan evaporation data, published information on pan evaporation, or data from a similar climatic location, may be used. Typically, storage capacity must be built into the system to accommodate months with low evaporation. The design must include a water balance for a one-year period. Transpiration may be included in the water balance where it can be adequately demonstrated.

18.3 Construction

18.3.1 Excavation may proceed only when the moisture content is below the soil's plastic limit. If a sample of soil taken at the depth of the proposed bottom of the system forms a wire, instead of crumbling, when one attempts to roll it between the hands, the soil is too wet to excavate.

18.3.2 The distribution pipes must have drain rock extending to the bottom of the system and be covered with a minimum of 2 inches of drain rock.

18.3.3 The ETA construction must be completed in such a manner to prevent compaction of the bed surface. The maximum depth from the top of the laterals to the surface of the topsoil must not exceed 18 inches.

18.3.4 The drain rock must be covered completely with drainage fabric, layers of untreated construction paper, or 2 inches of straw to prevent the soil cover from entering the media.

18.3.5 A 4-inch diameter, standing check pipe with both ends capped (only the bottom cap should be glued) must be installed. Several 1/8-inch to ¼-inch diameter holes should be drilled in the bottom of the pipe and covered with filter cloth. Check pipe should be anchored in fill material to prevent the pipe from being pulled out of the bed.

18.3.6 A berm surrounding the bed must be constructed to ensure that storm water or other runoff does not enter the bed.

18.3.7 The backfill topsoil material must be loamy sand or sandy loam. The topsoil cap must be between 6 to 12 inches in depth. It must be mounded above natural grade, with a minimum of one percent slope, to allow for settling and to direct runoff away from the system.

18.3.8 f the system is intended to remove nitrogen, a complete description of the nitrification and denitrification processes must be provided in detail, including the unit where it occurs, carbon source, feed rates, loading rates, pumps, controls, and other mechanisms necessary.

18.3.9 A detailed set of plans and specifications and an operation and maintenance manual are required. The operation and maintenance plan must meet the requirements in Appendix D.

CHAPTER 19

EVAPOTRANSPIRATION SYSTEMS

19.1 Location

Evapoptranspiration (ET) systems must meet all minimum separation distances in ARM Title 17, chapter 36, subchapter 3 or 9. Distances must be measured from the edge of the liner. ET systems may not be installed on land with a slope greater than 6 percent.

19.2 The material in the ET system must be at least 24 inches deep and must be washed coarse sand or drain rock. Testing must be provided to document the void ratio used.

19.3 Design

19.3.1 A watertight liner of at least 30-mil thickness must be installed to contain the effluent. Seams for a synthetic liner must be completely sealed in accordance with the manufacturer's recommendations.

19.3.2 There must be a minimum of 2 inches of sand fill between the soil surface and/or any projecting rocks and the liner.

19.3.3 Drain rock must be placed around the distribution pipes.

19.3.4 The pipes must be installed with the long dimension parallel to the land contour. The minimum spacing between pipes must be 6 feet, and the maximum spacing must be 8 feet.

19.3.5 The volume of the ET system will be based upon 90 percent of the pan evaporation, minus effluent, plus precipitation for the wettest year in a 10-year period. In the wettest year in a 10-year period, the design must show that total water lost through evaporation equals or exceeds the total water gained through precipitation and effluent discharge. Due to lack of pan evaporation data, published information on pan evaporation, or data from a similar climatic location, may be used. Typically, storage capacity must be built into the system to accommodate months with low evaporation. The design report must include a water balance for a one-year period.

19.4 Construction

19.4.1 Construction should be initiated immediately after preparation of the liner by placing all of the fill needed to a minimum depth of 24 inches. Trench sidewalls should be protected by placing synthetic filter fabric as a liner when the media is coarse sand.

19.4.2 The bottom of each trench or bed must be level throughout to ensure uniform distribution of effluent.

19.4.3 The distribution pipes must have 6 inches of drain rock underneath and must be covered with a minimum of 2 inches of drain rock.

19.4.4 The gravel or rock filter media must be covered completely with synthetic drainage fabric to prevent the soil cover from entering the media.

19.4.5 A 4-inch diameter, standing check pipe with both ends capped (only the bottom cap should be glued) must be installed. Several 1/8-inch to ¼-inch diameter holes should be drilled in the bottom of the pipe and covered with filter cloth. Check pipe should be anchored in fill material to prevent the pipe from being pulled out of the bed.

19.4.6 The backfill material must be loamy sand or sandy loam. The topsoil cap must be between 6 to 12 inches in depth. It must be mounded above natural grade, with a minimum of one percent slope, to allow for settling and to direct runoff away from the system.

19.4.7 A berm surrounding the bed must be constructed to ensure that storm water or other runoff does not enter the bed. The berm must be 6 to 12 inches above the natural grade of the site.

19.4.8 If the system is intended to remove nitrogen, a complete description of the nitrification and denitrification processes must be provided in detail, including the unit where it occurs, carbon source, feed rates, loading rates, pumps, controls, and other mechanisms necessary.

19.4.9 A detailed set of plans and specifications and an operation and maintenance manual are required. The operation and maintenance plan must meet the requirements in Appendix D.

CHAPTER 20

AEROBIC WASTEWATER TREATMENT UNITS

20.1 General

Aerobic treatment units (ATUs) are concrete tanks or other containers of various configurations that provide for aerobic biodegradation or decomposition of the wastewater components by bringing the wastewater in contact with air by some mechanical means. A means of securing continuous operation and maintenance of these systems (such as a county sewer district) must be approved by the county health department prior to Department approval. ATU systems must be recorded on the property Deed of Trust.

20.2 Types of devices/systems

For the purposes of this circular, there are two types of aerobic devices or systems:

20.2.1 Those devices or systems designed to treat residential strength wastewater.

20.2.2 Those devices or systems designed to treat high-strength wastewater to at least residential strength wastewater.

20.3 Design of the Individual Treatment Device

20.3.1 ATUs are exclusively proprietary products representing a wide variety of designs, materials, and methods of assembly

20.3.2 Reliability and performance

20.3.2.1 The individual treatment device must have been tested by a laboratory independent from the manufacturer of that device.

A. For Type 1, aerobic treatment devices (those designed to treat residential strength wastewater), the testing criteria and performance must be at least equal to that specified and required in NSF Standard No. 40 for Class 1 certification.

B. For Type 2, aerobic treatment devices (those designed to treat high-strength wastewater to at least residential strength wastewater), the testing criteria must at least be equal to that specified and required in NSF Standard No. 40, with a stress testing regime designed to evaluate the device under adverse conditions consistent with those anticipated for the specific wastewater treatment application(s). Device treatment performance must be at least equal to residential strength wastewater.

20.3.2.2 An adequate form of positive filtration will be required between the treatment device and the disposal component to prevent excessive solids from being carried over into the disposal component during periods of bulking.

20.3.3 Primary Treatment

20.3.4.1 For those ATUs using an external trash tank or septic tank (single or multiple compartment) to pretreat wastewater during performance testing:

A. A tank of at least equivalent design and volume capacity is required as a component of the wastewater system.

B. A conventional two-compartment tank may be used in the place of a single compartment tank, if consistent with the manufacturer's recommendations.

20.3.4.2 For those ATUs not using an external trash tank or septic tank to pretreat wastewater, primary treatment must be provided.

20.3.4 Advanced treatment (level II)

20.3.4.1 If the aerobic treatment unit is intended to attain a higher level of treatment than a septic tank, monitoring data must be submitted from at least three existing systems operating in similar climates and treating wastewater similar in characteristics to that to be treated. Monitoring must include at least six cumulative years of data, with one system being in operation at least three years. Minimum data submitted must include information on time to reach steady state conditions, required maintenance and operation, average daily flow, and influent values for each parameter (if other than residential strength wastewater), and effluent values for each parameter. Sample analysis is to be done by an independent laboratory.

20.3.4.2 If the system is intended to remove nitrogen, a complete description of the nitrification and denitrification processes must be provided in detail, including the unit where it occurs, carbon source, feed rates, loading rates, pumps, controls, and other mechanisms necessary.

20.3.4.3 The monitoring frequency must be sufficient to establish the treatment efficiency and response to varying wastewater flows, strengths, and climatic condition.

20.3.4.4 The Department will consider the complexity and maintenance required of the system, the stability of the processes, and the monitoring data in determining the adequacy, level of maintenance, and monitoring frequency of the system.

20.4 Access ports

20.4.1 Ground level access ports must be sized and located to facilitate installation, removal, sampling, examination, maintenance, and servicing of components or compartments that require routine maintenance or inspection.

20.4.2 Access ports must be protected against unauthorized intrusion. Acceptable protective measures include, but are not limited to, padlocks or covers that can be removed only with tools.

20.5 Failure sensing and signaling equipment

20.5.1 The ATU must possess a mechanism or process capable of detecting:

A. Failure of electrical and mechanical components that are critical to the treatment process, and

B. High liquid level conditions above the normal operation specifications.

20.5.2 The ATU must possess a mechanism or process capable of notifying the system owner of failure identified by the failure sensing components. The mechanism must deliver a visible and audible signal.

20.6 Installation

ATUs must be installed:

A. According to the manufacturer's instructions in compliance with state and local rules, and

B. By an authorized representative of the manufacturer and an installer who is approved by the reviewing authority.

20.7 Sampling ports

20.7.1 A sampling port must be designed, constructed, and installed to provide easy access for collecting a water sample from the effluent stream. The sampling port may be located within the ATU or other system component (such as a pump chamber) provided that the wastewater stream being sampled is representative of the effluent stream from the ATU.

20.7.2 For ATUs using effluent disinfection to meet the fecal coliform criteria, the sampling port must be located downstream of the disinfection component (including the contact chamber if chemical disinfection is used) so that samples will accurately reflect disinfection performance.

20.7.3 Sampling ports must be protected against unauthorized intrusion, as described in 20.4.2.

20.8 Design of the disposal component

20.8.1 If using soil absorption for disposal, the size of the effluent absorption area must be the same as for a standard absorption trench system. No reduction in absorption system area may be allowed. If monitoring data is collected as required in 20.3.4, and that data clearly indicates the following effluent quality parameters are met, the absorption system size may be reduced by 50 percent:

BOD_5 – 30-day average of less than 10 mg/L
TSS – 30-day average of less than 10 mg/L
Fecal coliform – 30-day geometric mean less than 800 coliform/100 ml

20.8.2 If an absorption system size reduction is allowed, adequate space must still be provided for an absorption area (and replacement area) large enough for a standard absorption trench system.

20.9 A detailed set of plans and specifications and an operation and maintenance manual are required. The operation and maintenance plan must meet the requirements outlined in Appendix D.

20.9.1 Service-related obligations

20.9.1.1 In the event that a mechanical or electrical component of the ATU requires off-site repair, the local authorized representative must maintain a stock of mechanical and electrical components that can be temporarily installed until repairs are completed if repairs are expected to render the unit inoperable for longer than 24 hours.

20.9.1.2 Emergency service must be available within 48 hours of a service request.

20.9.1.3 The ATU service provider must possess adequate knowledge and skill regarding on-site wastewater treatment, effluent disposal concepts, and system function. The service provider must be:

A. Product-certified by each manufacturer for any ATUs they intend to serve,

B. Able to provide documentation of product certification as evidence upon request, and

C. Able to demonstrate competency in the servicing (O & M) of on-site wastewater systems.

20.9.1.4 O & M service contracts establish the initial and on-going relationship between the O & M service provider and system owner. The service provider may be the ATU manufacturer/service representative of the system owner. The contract must identify the roles and responsibilities assigned to the service provider. The specifics of O & M service contracts may vary product-to-product and locality-to-locality, but all O & M service contracts must include information/conditions of agreement such as:

A. Owner's name and address;

B. Property address and legal description;

C. Local health department permit requirements;

D. Specific contracts/owner address, service provider, and local health department;

E. Detail of service to be provided;

F. Schedule of service provider duties;

G. Cost and length of service contract/time period;

H. Details of product warranty;

I. Owner's responsibilities under the contract and routine operation of the wastewater treatment and disposal system;

J. Document recording, such as notification to the mortgage-holder or attachment to the deed of trust.

20.9.1.5 O & M service record keeping and reports required for the local health jurisdiction must specify:

A. What data is to be reported,

B. To whom the reports are to be submitted,

C. The format for presenting information, and

D. The frequency of reporting.

CHAPTER 21

CHEMICAL NUTRIENT-REDUCTION SYSTEMS

21.1 General

A means of securing continuous maintenance and operation of the system must be approved by the reviewing authority.

21.2 Design

Specific design criteria will not be outlined in this document due to the various alternatives and design complexity involved. The EPA manual, *On-Site Wastewater Treatment Systems Manual* (February 2002), pages TFS-41 to 52, will be used as a guideline for the design of these systems.

21.3 Maintenance and Operation

A detailed set of plans and specifications and an operation and maintenance manual are required. The operation and maintenance plan must meet the requirements outlined in Appendix D.

CHAPTER 22

EXPERIMENTAL SYSTEMS

22.1 General

Treatment systems not listed in this circular may receive a waiver for use as experimental systems. Experimental systems must only be considered under the following conditions:

22.1.1 The applicant must provide adequate information to the reviewing authority that ensures the system will effectively treat the wastewater in a manner that will prevent ground water contamination and will meet all of the requirements of ARM Title 17, chapter 36, subchapter 9. Failure to meet the requirements of ARM Title 17, chapter 36, subchapter 9 or any waiver, deviation, or variance conditions shall invalidate the approval and be grounds to order cessation of use of the system and buildings that the system serves.

22.1.2 The applicant must include a complete description of a scientific evaluation process to be carried out by a scientific, educational, governmental, or engineering organization.

22.1.3 The applicant must provide for any funding necessary to provide adequate design, installation, monitoring, and maintenance.

22.1.4 The system must be designed by a professional engineer, sanitarian, or other professional acceptable to the reviewing authority.

22.2 The reviewing authority may place any requirements or restriction it deems necessary on an experimental system. All requirements for conventional systems must apply to experimental systems except those specifically exempted by the waiver. An approval to construct an experimental system is not transferable from person to person. Applicants must provide for inspections to be made by persons acceptable to the reviewing authority. Monitoring and inspections must be conducted as required by the reviewing authority. The monitoring and inspection results must be submitted to the reviewing authority. The reviewing authority may require a redundant system (i.e., a system that meets the requirements of another chapter of this circular) be installed in parallel with the experimental system.

22.3 Any person who sells a property containing an experimental system must disclose all permit, monitoring, and maintenance requirements to the buyer.

22.4 Maintenance and operation

22.4.1 Continuous maintenance and operation must be provided for the life of the system by a management entity acceptable to the reviewing authority. The type of entity required and the degree of management will be commensurate with the complexity of the system and the site conditions.

22.4.2 The management entity must be responsible for monitoring the operation of the system.

22.4.2.1 Frequent inspections (as determined by the reviewing authority) of the mechanical equipment must be provided during the first 90-day start-up period.

22.4.2.2 The routine inspection schedule must be quarterly at a minimum.

22.4.2.3 Records, both of maintenance and performance, must be kept and submitted annually to the reviewing authority department.

22.4.2.4 All manufacturers of experimental systems must provide a maintenance and operation manual, which must be followed. The manual must contain detailed instructions on proper operation and maintenance procedures, including safety, a replacement parts list, public health considerations, limitations of the unit, detection of a malfunction, and expectations from a well functioning unit.

22.4.2.5 Notification to the service provider and the local health department must be made within two business days if, for some reason, a unit fails to function properly.

22.5 Advance treatment

22.5.1 If the experimental system is intended to attain a higher level of treatment than a septic tank, monitoring data must be submitted from at least three existing systems operation in similar climates and treating wastewater similar in characteristics to that to be treated. Monitoring must include a least six cumulative years of data, with one system being in operation at least three years. Minimum data submitted must include information on time to reach steady-state conditions, required maintenance and operation, average daily flow, and influent and effluent values for each parameter. Sample analysis is to be done by an independent laboratory.

22.5.2 The monitoring frequency must be sufficient to establish the treatment efficiency and response to varying wastewater flows, strengths, and climatic conditions.

22.5.3 The Department will consider the complexity and maintenance required of the system, the stability of the processes, and the monitoring data in determining the adequacy, level of maintenance, and monitoring frequency of the system.

CHAPTER 23

ABSORPTION BEDS

23.1 General

Absorption beds may be used as replacement wastewater treatment systems in existing lots where standard absorption trenches cannot be utilized. Absorption beds may be used as replacement for previously approved seepage pits when the reviewing authority has completed rewrite of the certificate of subdivision approval. Absorption beds may not be used to create new lots without an existing wastewater treatment system that has been in continuous use and was permitted by the reviewing authority.

23.2 Absorption beds must meet the following design requirements.

23.2.1 Absorption beds must be more than three feet wide, and must be at least two feet in depth, unless a limiting condition requires a lesser depth, but in no case may the bed be less than on foot in depth.

23.2.2 Absorption beds must not be constructed on unstabilized fill.

23.2.3 The excavation must be filled with a minimum of six inches of washed rock or six inches of ASTM C-33 sand.

23.2.4 Pressure dosing must be used unless another method of distribution is approved by the reviewing authority in accordance with Chapter 8.

23.4 Distribution piping – pressure dosing

23.4.1 Pressure dosing shall be in accordance with Chapter 9 and the following conditions shall also apply.

23.4.2 A minimum of two distribution pipes shall be installed.

23.4.3 Distribution piping should be separated by a minimum of 30 inches and a maximum of 48 inches.

23.4.4 Distribution piping should be covered by two inches of drain rock except when designed in accordance with Section 23.5.

23.4.5 Distribution piping should be installed 18 to 30 inches from the edge of the excavation..

23.4.6 Distribution piping shall be installed to ensure uniform distribution of effluent.

23.4.7 Drain rock must be covered with geofabric, or, if geofabric is unavailable, a straw layer of at least four inches in depth.

23.4.8 Backfill for beds should be loam type soils that do not form an impervious seal. The use of high clay or silt content soils for back filling should be avoided.

23.4.9 Absorption bed sizing is determined by flows in Chapter 5, the application rates in Chapter 9, or using the maximum area available. Absorption beds shall not be installed with soils that have percolation rates of greater than 60 minutes per inch.

23.4.10 Infiltration chambers may be used in absorption beds if the entire excavation has chambers installed. Infiltration chambers must be installed in accordance with this chapter and Chapter 13. No change in application rate or reduction in sizing will be allowed for chambers in absorption beds.

CHAPTER 24

HOLDING TANKS

24.1 General

Holding tank are used to hold wastewater until pumping occurs by a licensed septic tank pumping service and wastewater is disposed at an approved location.

24.2 Holding tanks are septic tanks that have no standard outlets and are modified to provide full time access for pumping.

24.2.1 Holding tanks must have a minimum capacity of 1000 gallons. Larger tank capacity may be required by the reviewing authority as determined on a case by case basis.

24.2.2 Holding tanks must meet the construction standards of chapter 7 except that no outlet opening shall be cast in the tank walls. Holding tanks installed where the seasonal groundwater table may reach any portion of the tank must be a single pour (seamless) tank design.

24.2.3 Holding tanks must have an audible or visual warning alarm that signals when the tank level has reached 75 percent of capacity. The tank must be pumped as soon as possible after the alarm is triggered and before the tank reaches 100 percent capacity.

24.2.4 Holding tanks must be stabilized against flotation if the tank is installed where seasonal groundwater may reach any portion of the tank.

24.2.5 Holding tanks must be waterproofed against infiltration and exfiltration.

24.2.6 Holding tanks must meet the separation distances and other requirements in the subdivision and county minimum standard regulations, ARM 17.36.101 through 1107.

CHAPTER 25

SEALED (VAULT) PIT PRIVY

25.1 General

A sealed pit privy is an underground vault for the temporary storage of non-water-carried wastewater. The vault must be pumped periodically and the wastewater disposed at a secondary treatment site.

25.2 Construction

25.2.1 The vault must be watertight, constructed of durable material and not subject to excessive corrosion, decay, frost damage or cracking.

25.2.2 The vault may be used in a floodplain or high groundwater area at public recreational facilities operated by governmental institutions provided that the floor surface is one foot above the floodplain elevation and the weight of the structure is adequate to prevent the vault from floating during high groundwater or a flood even when the vault is empty.

25.2.3 The access or pumping port should be located outside of any structure and should have a minimum diameter of 8 inches. This access must have a tight, locking lid.

25.2.4 The vault may be a modified septic tank with the inlet and outlet opening sealed. The toilet structure over the tank vault must meet construction standards for a pit privy.

25.3 Maintenance

The vault must be pumped as needed, prior to reaching the maximum capacity of the tank, by a licensed septic tank pumper.

CHAPTER 26

UNSEALED PIT PRIVY

26.1 General

A pit privy is a building containing a stool, urinal or seat over an excavation in natural soil for the disposal of undiluted black wastes (toilet wastes). Pit privies shall serve structures that have no pumping fixtures or running water (piped water supply). Pit privies are framed structures used for disposal of black wastes (toilet wastes) that meet setback distances of standard absorption trench excavations.

26.2 Construction

26.2.1 Pit privies shall be located to exclude surface water.

26.2.2 Pit privy buildings must be constructed to prohibit access to insects with openings no greater than 1/16 inch.

26.2.3 The pit must be vented with a screened flue or vent stack having a cross sectional area of at least 7 inches per seat and extending at least 12 inches above the roof of the building.

26.2.4 The pit privy must be constructed on a level site with the base of the building being at least 6 inches above the natural ground surface as measured 18 inches from the sides of the building.

26.2.5 The bottom of the pit should be between three feet (3') and six feet (6') below the original ground surface.

26.3 Abandoning Pit Privies

26.3.1 A pit privy should be abandoned when the waste comes within 16 inches of the ground surface.

26.3.2 A pit privy building should be either dismantled or moved to cover a new pit.

26.3.3 The pit shall be filled with soil, free of rock, with sufficient fill material to allow for 12 inches or more of settling. The site shall be marked.

CHAPTER 27

SEEPAGE PITS

27.1 General

Seepage pits may be used for replacement systems only and may not be constructed in unstabilized fill. Seepage pits are excavations in which a concrete ring(s) is placed and filled around the concrete ring with drain rock to receive effluent from the septic tank.

27.2 Design

27.2.1 Seepage pits shall be sized according to the permeability of the vertical stratum where wastewater will contact the soils.

27.2.2 A seepage pit that is excavated to a four-foot depth and a five-foot diameter shall be equivalent to 50 square feet of absorption area.

27.2.3 A seepage pit shall have a concrete ring with a minimum diameter of three feet and a minimum height of 3.5 feet. Concrete rings can be stacked to provide for additional absorption area.

27.2.4 The seepage pit shall have six inches of drain rock placed in the bottom of the excavation for bedding.

27.2.5 The concrete ring shall have a minimum of one foot of drain rock placed on the out side of the ring. A concrete lid shall be installed on each concrete ring or on the top most concrete ring if stacked.

27.2.6 Schedule 40 piping, or equivalent strength, shall be used to connect the septic tank or the distribution box to the concrete ring(s).

27.2.7 Drain rock must be covered with geofabric or synthetic drainage fabric, or if geofabric is unavailable, a straw layer of a least five inches in depth.

27.2.8 Effluent distribution to multiple seepage pits shall use a distribution box.

27.2.9 Seepage pits shall not be installed in soils that have percolation rates greater than 60 minutes per inch.

APPENDIX A

PERCOLATION TEST PROCEDURE 1

Properly conducted percolation tests are needed to determine absorption system site suitability and to size the absorption system. Percolation tests must be conducted within the boundary of the proposed absorption system. The percolation test must be completed by an individual approved by the reviewing authority.

Test hole preparation

1. Dig or bore holes 6 to 8 inches in diameter, with a maximum size of 10 inches, with vertical sides. The depth of the holes must be at the approximate depth of the proposed absorption trenches, typically 24 inches below ground. If hole is larger than 6 to 8 inches, place a piece of 4-inch diameter, perforated pipe inside the hole, and fill the space between the pipe and the walls of the hole with drain rock.

2. Roughen or scratch the bottoms and sides of the holes to provide natural unsmeared surfaces. Remove loose material. Place about 2 inches of ¾-inch washed gravel in the bottom of holes to prevent scouring during water addition.

3. Establish a reference point for measurements in or above each hole.

Soaking

1. Fill holes with clear water to a level at least 12 inches above the gravel.

2. If the first 12 inches of water seeps away in 60 minutes or less, add 12 inches of water a second time. If the second filling seeps away in 60 minutes or less, the percolation test should be run in accordance with the sandy soil test; proceed immediately with that test. As an alternative to proceeding with the test, if these conditions are met and documented, the percolation rate may be considered to be faster than 3 minutes per inch, and the test may be stopped.

3. If either the first 12 inches or the second 12 inches does not seep away in 60 minutes, the percolation test must be run in accordance with the test for other soils. In these other soils, maintain at least 12 inches of water in the hole for at least 4 hours to presoak the hole.

Test

1. Sandy soils (percolation rate of 10 minutes per inch or faster)

   Add water to provide a depth of 6 inches above gravel. Measure water level drop at least four times, in equally spaced intervals, in a 1 hour time period. Measure to nearest ¼ inch. Refill to 6-inch depth after each measurement. Do not exceed 6-inch depth of water. Use final water-level drop to calculate rate.

2. Other soils (percolation rate slower than 10 minutes per inch).

   Remove loose material on top of gravel. Add water to provide a depth of 6 inches above gravel. Measure water levels for a minimum of 1 hour. A minimum of four measurements must be taken. The test must continue until two successive readings yield percolation rates that do not vary by more than 15 percent, or until measurements have been taken for four hours. Do not exceed 6-inch depth of water. Use final water-level drop to calculate rate.

Records

Record the following information on the attached form, and include as part of the application:

- Date(s) of test(s),
- Location, diameter, and depth of each test hole,
- Time of day that each soak period began and ended,
- Time of day for beginning and end of each water-level drop interval,
- Each water-level drop measurement,
- Calculated percolation rate,
- Name and signature of person performing test,
- Name of owner or project name.

Rate Calculation

Percolation Rate = Time interval in minutes/Water-level drop in inches

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY
PERCOLATION TEST FORM

Owner Name ____

Project Name ____

Lot of Tract Number ____________________ Test Number ______________

Diameter of Test Hole ____________________ Depth of Test Hole __________

Date and Time Soak Period Began ____________ Ended __________________

Date Test Began ____

Distance of the reference point above the bottom of the hole ____________________

Test Results

Start Time of Day	End Time of Day	Time Interval (Minutes)	Initial Distance Below Reference Point	Final Distance Below Reference Point	Drop in Water Level (inches)	Percolation Rate (minutes/inch)

I certify that this percolation test was done in accordance with DEQ-4, Appendix A.

______________________ ______________________ ______________
Name (printed) Signature Date

____
Company

PERCOLATION TEST PROCEDURE II

The consultant may use either or both tests in choosing the value used in site evaluation. The results of all tests must be reported in the application, and the procedure used must be specified. Test Procedure II requires substantially more data be obtained at well-defined intervals. If this information is not properly obtained, the results are not valid and will not be accepted. The percolation test must be completed by an individual approved by the reviewing authority.

Note: This test is run without a pre-soak time period, therefore results can be obtained in a shorter time period.

Depth of tests

Tests must be taken entirely within the most dense, least permeable soil identified at the approximate depth of the absorption trench, as identified from the test pit(s) on the site.

Type of test hole

The test hole must be unlined, shaped like a vertically oriented cylinder with a diameter of 6 to 8 inches.

Preparation of test hole

Using a sharp instrument, carefully scrape the side walls of the hole to remove any smeared surface. This is particularly important in soils having a significant silt or clay content. Place 1 inch of clean fine to medium gravel in the bottom of the hole to reduce scouring. After this process the evaluator may place a perforated pipe at least 4 inches in diameter in the center of the hole and surround it with the same gravel that is in the bottom. This must be done if the type of test hole required above cannot be constructed. This process will help keep the side walls from falling and causing the bottom to clog. When possible, instead of pouring water directly from a bucket into the hole, use a hose to siphon water out of a suitably located reservoir; this will provide a higher degree of control over the rate of water entering the hole, thereby minimizing scouring.

Percolation test measurements

To begin the test, fill the hole with water up to a level 6 inches above the stone and allow it to drop the distance specified in the table below for seven consecutive runs. After each run, bring the water up to the 6-inch level. The time of each run, the refill time between each run, and the total elapsed time must be accurately recorded.

	Soil Texture		
	Coarse to Medium Sand	**Fine Sand to Silt Loam**	**Silts to Clay Loam**
Anticipated Percolation Rate (min/inch)	1-10	10-60	60-120
Drop (inches)	2	1	0.5

Determining the percolation rate

The rate of drop for each run is plotted on graph paper, with logarithmic scales on both axes (log/log graph paper) against the cumulative time of the seven runs, including the refill time. The best straight line is fitted to the seven data points and extrapolated out to one day (1,440 minutes) of cumulative time. The rate of drop after 1,440 minutes is the percolation rate. A mathematical computation of the line of best fit of the seven or more data values may be used in lieu of the graphical method. The reviewing authority may require the mathematical computation of the line of best fit.

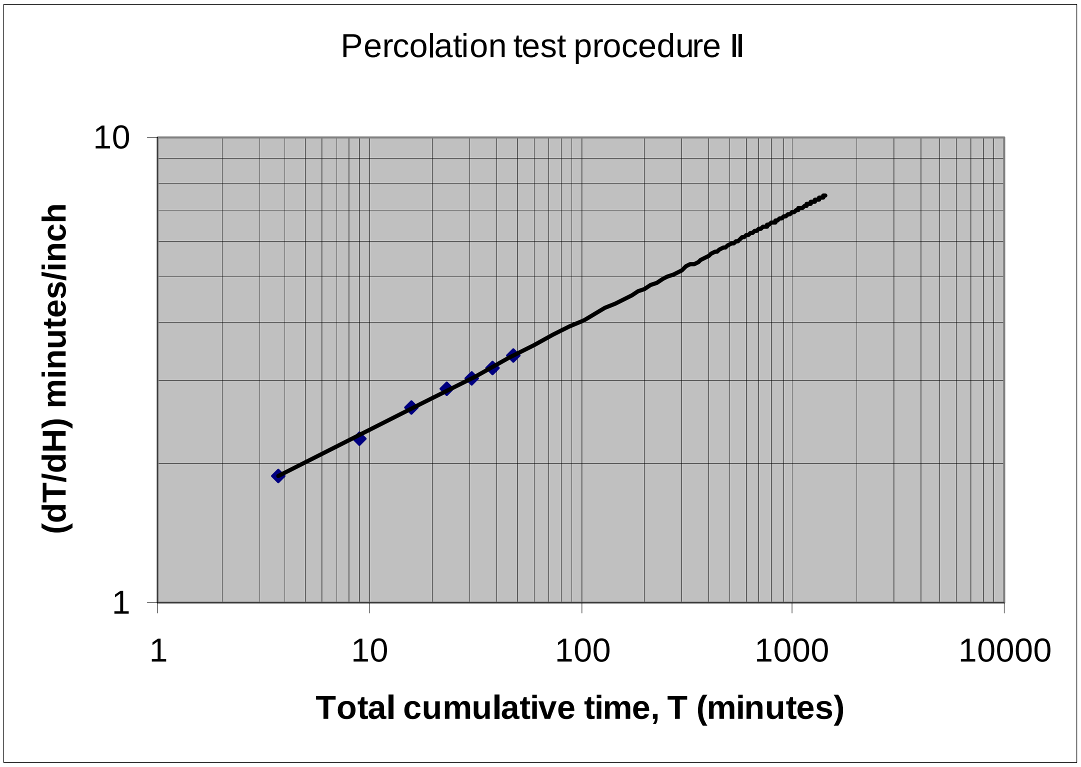
A typical data sheet is shown below, with units for each column noted below the table.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
				t	T	H	
Test #	Time @ Begin of Test Run	Time @ End of Test Run	Fill Time (sec)	Time for Specific Drop (mm)	Total Time Since Start of Test (min)	Total Drop Since Start of Test (inches)	dT/dH min/inch
1	3:32:15	3:36:00	30	3.75	3.75	2	1.88
2	3:36:30	3:41:15	45	5.25	9.00	4	2.25
3	3:42:00	3:48:00	10	6.75	15.75	6	2.63
4	3:48:10	3:55:15	45	7.25	23.00	8	2.88
5	3:56:00	4:03:30	30	7.25	30.25	10	3.03
6	4:04:00	4:11:45	35	8.25	38.50	12	3.21
7	4:12:20	4:20:45		9.00	47.50	14	3.39

Common units:
1. Number of test cycle (show all if more were run)
2. Start of test periods in hours, minutes, seconds
3. End of test periods in hours, minutes, seconds
4. Time to refill the test hole with water (seconds)
5. t – time in minutes to drop the predetermined distance for the test period
6. T – total cumulative time in minutes since the start of the first test
7. H – total measured drop in inches of water in the test hole since the start of the test
8. dT/Dt – the rate of water drop in minutes per inch

Test results

Based on the graphical plot show below, the percolation rate at 1,440 minutes is about 7.5 minutes per inch. This is the design percolation rate.


Percolation test procedure II
10
1
(dT/dH) minutes/inch
1
10
100
1000
10000
Total cumulative time, T (minutes)

APPENDIX B

SOILS AND SITE CHARACTERIZATION

Accurate description of soil types must be based on information within Appendix B for evaluating the soils in the area of proposed absorption system to determine if suitable conditions for wastewater treatment and disposal exist. Appendix B provides guidance for reporting soil characteristics using terminology generally accepted by the field of soil science.

Definitions

Bedrock means material that cannot readily (easily) be excavated by power equipment, or material that is jointed, fractured, or has cohesive structure that does not allow water to pass through or has insufficient quantities of fines within fractures or layers to allow for the adequate treatment of wastewater.

Escarpment means any slope greater than 50 percent, which extends vertically 6 feet or more as measured from toe to top.

Limiting layer means bedrock, an impervious layer or seasonally high ground water.

Mottling or redoximorphic features means soil properties associated with wetness that results from the reduction and oxidation of iron and manganese compounds in the soil after saturation with water and desaturation, respectively.

Natural soil means soil that has developed in place through natural processes, and where no fill material had been added.

Seasonally high ground water means the minimum depth, at any season of the year, to the upper surface of the zone of saturation, measured from the ground surface, as measured in an unlined hole or perforated monitoring well during the time of year when the water table is the highest. The term includes the upper surface of a perched water table.

Slope means the rate that a ground surface declines in feet per 100 feet. It is expressed as percent of grade.

Soil profile means a description of the soil to a depth of 7 to 10 feet using the USDA soil classification system.

Soil texture means the amount of sand, silt, or clay, measured separately in soil mixture.

Soil Texture

Soil texture refers to the weight proportion of the separates for particles less than 2 mm, as determined from a laboratory particle-size distribution. Field estimates should be checked against laboratory determinations, and field criteria should be adjusted as necessary. Field criteria for estimating soil texture must be chosen to fit the soils of the area. Sand particles feel gritty and can be seen individually with the naked eye. Silt particles cannot be seen individually without magnification; they have a smooth feel to the fingers when dry or wet. In some places, clay soils are sticky; in others, they are not. Soils dominated by montmorillonite clays, for example, feel different than soils that contain similar amounts of micaceous or kaolinitic clay.

Definitions of the soil texture classes according to distribution of size classes of mineral particles less than 2 mm in diameter are as follows:

Sands: 85 percent or more sand and the percentage of silt plus 1.5 times the percentage of clay is 15 or less.

> *Coarse sand*: 25 percent or more very coarse and coarse sand and less than 50 percent any other single grade of sand.
>
> *Sand*: 25 percent or more very coarse, coarse, and medium sand (but less than 25 percent very coarse and coarse sand) and less than 50 percent either fine sand or very fine sand.
>
> *Fine sand*: 50 percent or more fine sand; or less than 25 percent very coarse, coarse, and medium sand and less than 50 percent very fine sand.
>
> *Very fine sand*: 50 percent or more very fine sand.

Loamy sands: At the upper limit, 85 to 90 percent sand and the percentage of silt plus 1.5 times the percentage of clay is 15 or more; at the lower limit, 70 to 85 percent sand and the percentage of silt, plus twice the percentage of clay, is 30 or less.

> *Loamy coarse sand*: 25 percent or more very coarse and coarse sand and less than 50 percent any other single grade of sand.
>
> *Loamy sand:* 25 percent or more very coarse, coarse, and medium sand (but less than 25 percent very coarse and coarse sand) and less than 50 percent either fine sand or very fine sand.
>
> *Loamy fine sand*: 50 percent or more fine sand; or less than 50 percent very fine sand and less than 25 percent very coarse, coarse, and medium sand.
>
> *Loamy very fine sand:* 50 percent or more very fine sand.

Sandy loams*:* 20 percent or less clay and 52 percent or more sand and the percentage or silt plus twice the percentage of clay exceeds 30; or less than 7 percent clay, less than 50 percent silt, and between 43 and 52 percent sand.

> *Coarse sandy loam*: 25 percent or more very coarse and coarse sand and less than 50 percent any other single grade of sand.
>
> *Sandy loam*: 30 percent or more very coarse, coarse, and medium sand (but less than 25 percent very coarse and coarse sand) and less than 30 percent either fine sand or very fine sand.

Fine sandy loam: 30 percent or more fine sand and less than 30 percent; or between 15 to 30 percent very coarse, coarse, and medium sand; or more than 40 percent fine and very fine sand, at least half of which is fine sand, and less than 15 percent very coarse, coarse, and medium sand.

Very fine sandy loam: 30 percent or more very fine sand; or more than 40 percent fine and very fine sand, at least half of which is very fine sand, and less than 15 percent very coarse, coarse, and medium sand.

Loam: 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Silt loam: 50 percent or more silt and 12 to 27 percent clay; or 50 to 80 percent silt and less than 12 percent clay.

Silt: 80 percent or more silt and less than 12 percent clay.

Sandy clay loam: 20 to 35 percent clay, less than 28 percent silt, and 45 percent or more sand.

Clay loam*:* 27 to 40 percent clay and 20 to 45 percent sand.

Silty clay loam*:* 27 to 40 percent clay and less than 20 percent sand.

Sandy clay*:* 35 percent or more clay and 45 percent or more sand.

Silty clay*:* 40 percent or more clay and 40 percent or more silt.

Clay: 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Necessarily these verbal definitions are somewhat complicated. The texture triangle is used to resolve problems related to word definitions. The eight distinctions in the sand and loamy sand groups provide refinement greater than can be consistently determined by field techniques. Only those distinctions that are significant to use and management and that can be consistently made in the field should be applied.

Particle size distribution

Particle-size distribution (fine earth or less than 2 mm) is determined in the field mainly by feel. The content of rock fragments is determined by estimating the proportion of the soil volume that they occupy.

Soil

The United States Department of Agriculture uses the following size separates for the <2 mm mineral material:

Very coarse sand:	2.0 – 1.0 mm
Coarse sand:	1.0 – 0.5 mm

Medium sand:	0.5 – 0.25 mm
Fine sand:	0.25 – 0.10 mm
Very fine sand:	0.10 – 0.05 mm
Silt:	0.05 – 0.002 mm
Clay:	<0.002 mm

The texture classes are sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. Subclasses of sand are subdivided into coarse sand, sand, fine sand, and very fine sand. Subclasses of loamy sands and sandy loams that are based on sand size are named similarly.

Rock fragments

Rock fragments are unattached pieces of rock 2 mm in diameter or larger that are strongly cemented or more resistant to rupture. Rock fragments include all sizes that have horizontal dimensions less than the size of a pedon.

Rock fragments are described by size, shape, and, for some, the kind of rock. The classes are pebbles, cobbles, channers, flagstones, stones, and boulders. If a size or range of sizes predominates, the class is modified, as for example: "fine pebbles," "cobbles 100 to 150 mm in diameters," "channers 25 to 50 mm in length."

Gravel is a collection of pebbles that have diameters ranging from 2 to 75 mm. The terms "pebble" and "cobble" are usually restricted to rounded or subrounded fragments; however, they can be used to describe angular fragments if they are not flat. Words like chert, limestone, and shale refer to a kind of rock, not a piece of rock. The upper size of gravel is 3 inches (75 mm). The 5-mm and 20-mm divisions for the separation of fine, medium, and coarse gravel coincide with the sizes of openings in the "number 4" screen (4.76 mm) and the "3/4 inch" screen (19.05 mm) used in engineering.

The 75-mm (3 inch) limit separates gravel from cobbles. The 250-mm (10 inch) limit separates cobbles from stones, and the 600-mm (24 inch) limit separates stones from boulders. The 150-mm (channers) and the 380-mm (flagstones) limits for thin, flat fragments follow conventions used for many years to provide class limits for plate-shaped and crudely spherical rock fragments that have about the same soil use implications as the 250-mm limit for spherical shapes.

Rock fragments in soil

The adjectival form of a class name of rock fragments (Table C-1) is used as a modifier of the textural class name: "gravelly loam," "stony loam." The following classes, based on volume percentages, are used:

> *Less than 15 percent*: No adjectival or modifying terms are used in writing for contrast with soils having less than 15 percent pebbles, cobbles, or flagstones. The adjective "slightly" may be used, however, to recognize those soils used for special purposes.
>
> *15 to 35 percent*: The adjectival term of the dominant kind of rock fragment is used as a modifier of the textural terms: "gravelly loam," "channery loam," "cobbly loam."

35 to 60 percent: The adjectival term of the dominant kind of rock fragment is used with the word "very" as a modifier of the textural term: "very gravelly loam," "very flaggy loam."

More than 60 percent: If enough fine earth is present to determine the textural class (approximately 10 percent or more by volume), the adjectival term of the dominant kind of rock fragment is used with the word "extremely" as a modifier of the textural term: "extremely gravelly loam," "extremely bouldery loam." If there is too little fine earth to determine the textural class (less than about 10 percent by volume), they term "gravel," "cobbles," "stones," or "boulders" is used as appropriate.

The class limits apply to the volume of the layer occupied by all pieces of rock larger than 2 mm. The soil generally contains fragments smaller or larger than those identified in the term. For example, a stony loam usually contains pebbles, but "gravelly" is not mentioned in the name. The use of a term for larger pieces or rock, such as boulders does not imply that the pieces are entirely within a given soil layer. A simple boulder may extend through several layers.

Table B-1
Terms for Rock Fragments

Shape and size	Noun	Adjective
Spherical, cubelike, or equiaxial:		
2-75 mm diameter	Pebbles	Gravelly
2-5 mm diameter	Fine	Fine gravelly
5-20 mm diameter	Medium	Medium gravelly
20-75 mm diameter	Coarse	Coarse gravelly
75-250 mm diameter	Cobbles	Cobbly
250-600 mm diameter	Stones	Stony
> 600 mm diameter	Boulders	Bouldery
Flat:		
2-150 mm long	Channers	Channery
150-380 mm long	Flagstones	Flaggy
380-600 mm long	Stones	Stones
> 600 mm long	Boulders	Bouldery

Table B-2
Classes of Surface Stones and Boulders in Terms of Cover and Spacing

Class	Percentage of surface covered	Distance in meters between stones or boulders if the diameter is: 0.25m[1]	0.6m	1.2m	Name
1	0.01 – 0.1	>8	>20	>37	Stony or bouldery
2	0.1 – 3.0	1 – 8	3 – 20	6 – 37	Very stony or very bouldery
3	3.0 – 15	0.5 – 1	1 –3	2 - 6	Extremely stony or extremely bouldery
4	15 – 50	0.3 – 0.5	0.5 – 1	1 – 2	Rubbly
5	50 – 90	<0.3	<0.05 – 1	<1	Very rubbly

[1]0.38 m if flat

Soil Color

Elements of soil color descriptions are the color name, the Munsell notation, the water state, and the physical state: "brown (10YR 5/3), dry, crushed, and smoothed."

Physical state is recorded as broken, rubbed, crushed, or crushed and smoothed. The term "crushed" usually applies to dry samples and "rubbed" to moist samples. If unspecified, the surface is broken. The color of the soil is recorded for a surface broken through a ped, if a ped can be broken as a unit.

The color value of most soil material becomes lower after moistening. Consequently, the water state of a sample is always given. The water state is either "moist" or "dry." The dry state for color determinations is air-dry and should be made at the point where the color does not change with additional drying. Color in the moist state is determined on moderately moist or very moist soil material and should be made at the point where the color does not change with additional moistening. The soil should not be moistened to the extent that glistening takes place, as color determinations of wet soil may be in error because of the light reflection of water films.

Munsell notation is obtained by comparison with a Munsell system color chart. The most commonly used chart includes only about one-fifth of the entire range of hues. It consists of about 250 different colored papers, or chips, systematically arranged on hue cards according to their Munsell notations.

The Munsell color system uses three elements of color – hue, value, and chroma – to make up a color notation. The notation is recorded in the form: hue, value/chroma – for example, 5Y 6/3.

> *Hue* is a measure of the chromatic composition of light that reaches the eye. The Munsell system is based on five principle hues: red (R), yellow (Y), green (G), blue (B), and purple (P). Five intermediate hues representing midpoints between each pair of principle hues complete the 10 major hue names used to describe the notation. The intermediate

hues are yellow-red (YR), green-yellow (GY), blue-green (BG), purple-blue (PB), and red-purple (RP).

Value indicates the degree of lightness or darkness of a color in relation to a neutral gray scale. On a neutral gray (achromatic) scale, value extends from pure black (0/) to pure white (10/). The value notation is a measure of the amount of light that reaches the eye under standard lighting conditions.

Chroma is the relative purity or strength of the spectral color. Chroma indicates the degree of saturation of neutral gray by the spectral color. The scales of chroma for soils extend from /0 to a chroma of /8 as the strongest expression of color used for soils.

Conditions for Measuring Color

The quality and intensity of the light affect the amount and quality of the light reflected from the sample to the eye. The moisture content of the sample and the roughness of its surface affect the light reflected. The visual impression of color from the standard color chips is accurate only under standard conditions of light intensity and quality. Color determination may be inaccurate early in the morning or late in the evening. When the sun is low in the sky or the atmosphere is smoky, the light reaching the sample and the light reflected is redder. Even though the same kind of light reaches the color standard and the sample, the reading of sample color at these times is commonly one or more intervals of hue redder than at midday. Colors also appear different in the subdued light of a cloudy day than in bright sunlight. If artificial light is used, as for color determinations in an office, the light source used must be as near the white light of midday as possible. With practice, compensation can be made for the differences, unless the light is so subdued that the distinctions between color chips are not apparent. The intensity of incidental light is especially critical when matching soil to chips of low chroma and low value.

Roughness of the reflecting surface affects the amount of reflected light, especially if the incidental light falls at an acute angle. The incidental light should be as nearly as possible at a right angle. For crushed samples, the surface is smoothed; the state is recorded as “dry, crushed, and smoothed.”

Recording guidelines

Uncertainty. Under field conditions, measurements of color are reproducible by different individuals within 2.5 units of hue (one card) and 1 unit of value and chroma.

Dominant color. The dominant color is the color that occupies the greatest volume of the layer. Dominant color (or colors) is always given first among those of a multicolored layer. It is judged on the basis of colors of a broken sample. For only two colors, the dominant color makes up more than 50 percent of the volume. For three or more colors, the dominant color makes up more of the volume of the layer than any other color, although it may occupy less than 50 percent.

Mottling. Mottling refers to repetitive color changes that cannot be associated with compositional properties of the soil. Redoximorphic features are a type of mottling that is associated with wetness. A color pattern that can be related to the proximity to a ped surface of other organizational or compositional feature is not mottling. Mottle description follows the dominant color. Mottles are described by quantity, contrast, color, and other attributes in that order.

Quantity is indicated by three areal percentage classes of the observed surface:

Few:	less than 2 percent,
Common:	2 to 20 percent, and
Many:	more than 20 percent.

The notations must clearly indicate to which colors the terms for quantity apply.

Size refers to dimensions as seen on a plane surface. If the length of a mottle is not more than two or three times the width, the dimension recorded is the greater of the two. If the mottle is long and narrow, as a band of color at the periphery of a ped, the dimension recorded is the smaller of the two and the shape and location are also described. Three size classes are used:

Fine:	smaller than 5 mm,
Medium:	5 to 15 mm, and
Coarse:	larger than 15 mm.

Contrast refers to the degree of visual distinction that is evident between associated colors:

Faint: Evident only on close examination, faint mottles commonly have the same hue as the color to which they are compared and differ by no more than 1 unit of chroma or 2 units of value. Some faint mottles of similar but low chroma and value differ by 2.5 units (one card) of hue.

Distinct: Readily seen but contrast only moderately with the color to which they are compared. Distinct mottles commonly have the same hue as the color at which they are compared but differ by 2 to 4 units of chroma or 3 to 4 units of value; or differ from the color to which they are compared by 2 units (one card) of hue but by no more than 1 unit of chroma or 2 units of value.

Prominent: Contrast strongly with the color to which they are compared. Prominent mottles are commonly the most obvious color feature of the section described. Prominent mottles that have medium chroma and value commonly differ from the color to which they are compared by at least 5 units (two pages) of hue if chroma and value are the same; at least 4 units of value or chroma if the hue is the same; or at least 2 unit of chroma or 2 units of value if hue differs by 2.5 units (one card).

Contrast is often not a simple comparison of one color with another but is a visual impression of the prominence of the one color against a background commonly involving several colors.

Soil structure

Soil structure refers to units composed of primary particles. The cohesion within these units is greater than the adhesion among units. As a consequence, under stress, the soil mass tends to rupture along predetermined planes or zones. Three planes or zones, in turn, form the boundary. A structural unit that is the consequence of soil development is called a ped. The surfaces of peds persist through cycles of wetting and drying in place. Commonly, the surface of the ped and its interior differ as to composition or organization, or both, because of soil development.

Some soils lack structure and are referred to as structureless. In sturctureless layers or horizons, no units are observable in place or after the soil has been gently disturbed, such as by tapping a space containing a slice of soil against a hard surface or by dropping a large fragment on the ground. When structureless soils are ruptured, soil fragments, single grains, or both, result. Structureless soil material may be either single grain or massive. Soil material of single grains lacks structure. In addition, it is loose. On rupture, more than 50 percent of the mass consists of discrete mineral particles.

Some soils have simple structure, each unit being an entity without component smaller units. Others have compound structure, in which large units are composed of smaller units separated by persistent planes of weakness.

In soils that have structure, the shape, size, and grade (distinctness) of the units are described. Field terminology for soil structure consists of separate sets of terms designating each of the three properties, which by combination form the names for structure.

Shape

Several basic shapes of structural units are recognized in soils.

> *Platy:* The units are flat and platelike. They are generally oriented horizontally. A special form, lenticular platy structure, is recognized for plates that are thickest in the middle and thin toward the edges.
>
> *Prismatic:* The individual units are bounded by flat to rounded vertical faces. Units are distinctly longer vertically, and the faces are typically casts or molds of adjoining units. Vertices are angular or subrounded; the tops of prisms are somewhat indistinct and normally flat.
>
> *Columnar:* The units are similar to prisms and are bounded by flat or slightly rounded vertical faces. The tops of columns, in contrast to those prisms, are very distinct and normally rounded.
>
> *Blocky:* The units are block like or polyhedral. They are bounded by flat or slightly rounded surfaces that are casts of the faces of surrounding peds. Typically, blocky structural units are nearly equidimensional but grade to prisms and to plates. The structure is described as angular blocky if the faces intersect at relatively sharp angles; a subangular blocky if the faces are a mixture of rounded and plane faces and the corners are mostly rounded.
>
> *Granular:* The units are approximately spherical or polyhedral and are bounded by curved or very irregular faces that are not casts of adjoining peds.

Size

Five classes are employed: very fine, fine, medium, coarse, and very coarse. The size limits differ according to the shape of the units. The size limit classes are given in table B-3. The size limits refer to the smallest dimension of plates, prisms, and columns.

Table B-3
Size Classes of Soil Structure

	Shape of Structure			
Size Classes	**Platy[1] mm**	**Prismatic & Columnar mm**	**Blocky mm**	**Granular mm**
Very Fine	<1	<10	<5	<1
Fine	1 – 2	10 – 20	5 – 10	1 – 2
Medium	2 – 5	20 – 50	10 – 20	2 – 5
Coarse	5 – 10	50 – 100	20 – 50	5 – 10
Very Coarse	>10	>100	>50	>10

[1] In describing plates, “thin” is used instead of “fine” and “thick” instead of “coarse.”

Grade

Grade describes the distinctness of units. Criteria are the ease of separation into discrete units and the proportion of units that hold together when the soil is handled. Three classes are used:

Weak: The units are barely observable in place. When gently disturbed, the soil material parts into a mixture of whole and broken units and much material that exhibits no planes of weakness. Faces that indicate persistence through wet-dry-wet cycles are evident if the soil is handled carefully. Distinguishing structurelessness from weak structure is sometimes difficult. Weakly expressed structural units in virtually all soil materials have surfaces that differ in some way from the interiors.

Moderate: The units are well formed and evident in undisturbed soil. When disturbed, the soil material parts into a mixture of mostly whole units, some broken units, and material that is not in units. Peds part from adjoining peds to reveal nearly entire faces that have properties distinct from those of fractured surfaces.

Strong: The units are distinct in undisturbed soil. They separate cleanly when the soil is disturbed. When removed, the soil material separates mainly into whole units. Peds have distinctive surface properties.

Three terms for soils structure are combined in order (1) grade, (2) size, (3) shape. “Strong fine granular structure” is used to describe a soil that separates almost entirely into discrete units that are loosely packed, roughly spherical, and mostly between 1 and 2 mm in diameter.

Compound structure

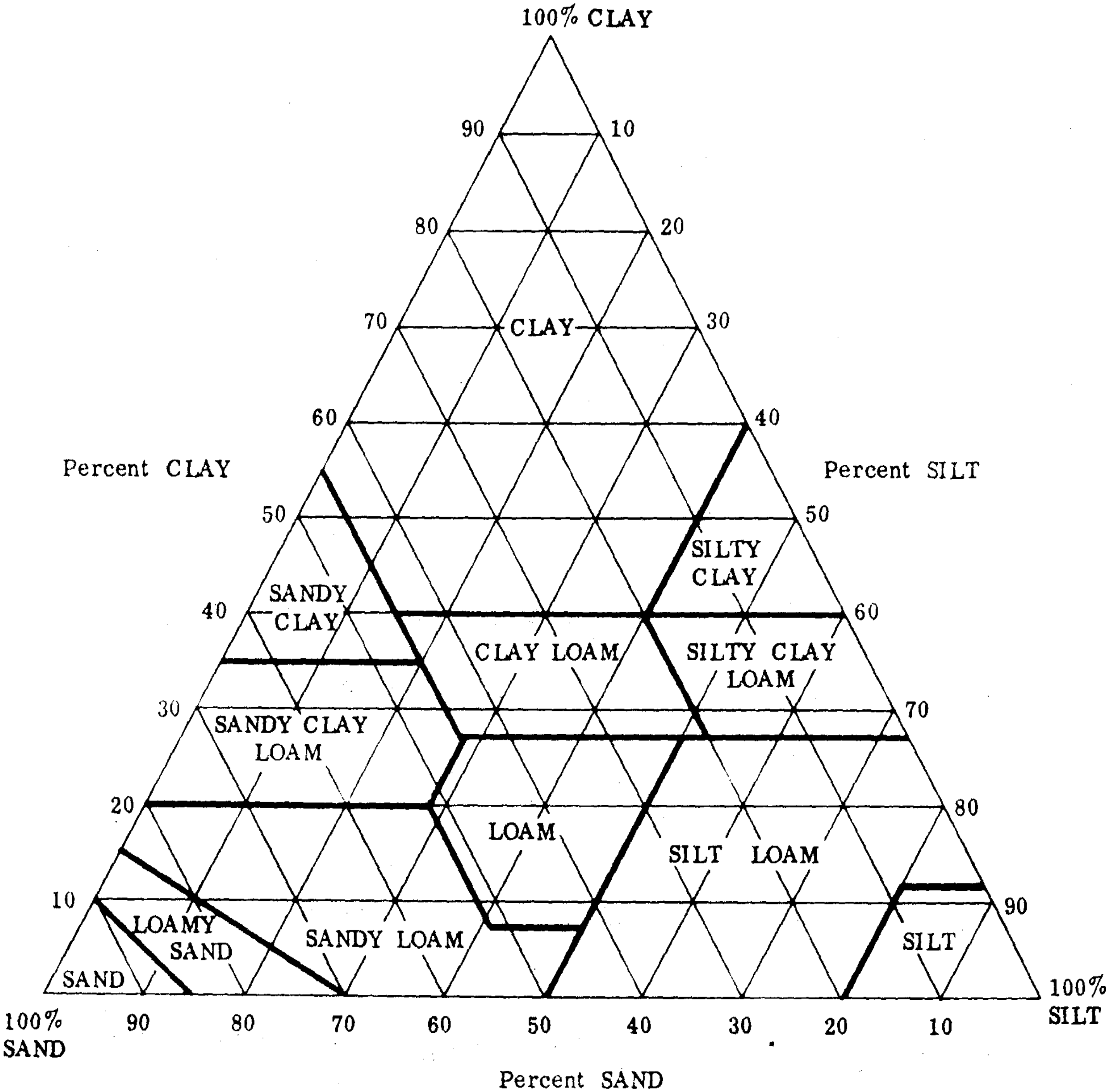
Smaller structural units may be held together to form larger units. Grade, size, shape are given for both, and the relationship of one set to the other is indicated: "strong medium blocks within moderate coarse prisms," or "moderate coarse prismatic structure parting to strong medium blocky."

Concentrations

The features discussed here are identifiable bodies within the soil that were formed by pedogenesis. Some of these bodies are thin and sheetlike; some are nearly equidimensional; others have irregular shapes. They may contrast sharply with the surrounding material in strength, composition, or internal organization. Masses are non-cemented concentrations of substances that commonly cannot be removed from the soil as a discrete unit. Most accumulations consist of calcium carbonate, fine crystals of gypsum or more soluble salts, or iron and manganese oxides. Except for very unusual conditions, masses have formed in place.

Nodules and concretions are cemented bodies that can be removed from the soil intact. Composition ranges from material dominantly like that of the surrounding soil to nearly pure chemical substances entirely different from the surrounding material.

Concretions are distinguished from nodules on the basis of internal organization. Concretions have crude internal symmetry organized around a point, a line, or a plane. Nodules lack evident, orderly internal organization.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APPENDIX C

GROUND WATER OBSERVATION WELL INSTALLATION AND MEASURING PROCEDURES

Observation Schedule

Observation must be done during the time when ground water levels are highest. This is typically during spring runoff or during the irrigation period, but may also be at some other time during the year. Observation must be done weekly or more frequently during the appropriate periods of suspected high ground water. Observation must include at least two weeks of observation prior to and after the ground water peak, otherwise the reviewing authority may reject the results. The applicant is encouraged to consult with the state and/or county before installing wells. The monitoring must be completed by an individual approved by the reviewing authority.

Surface water levels may be indicative of the ground water levels that may peak several weeks after spring runoff and irrigation seasons.

Local conditions may indicate that there is more than one geologic horizon that can become seasonally saturated. This may require observation wells to be installed at different horizons. The well should be placed in, but not extended through, the horizon that is to be monitored.

The reviewing authority may refuse to accept seasonal high ground water data when the total precipitation for the previous year (defined as May 1 of the previous year to April 30 of the current year), of April 1 snowpack equivalent, measured at the nearest officially recognized observation station, is more than 25 percent below the 30-year historical average. This is based upon the definition of drought conditions created by the National Drought Mitigation Center. The reviewing authority may consider soil morphology and data from nearby ground water observation sites with similar soil, geology, and proximity to streams or irrigation ditches, if available, to determine maximum ground water elevation during periods of drought.

Where to Install

The observation well(s) must be installed within 25 feet of the proposed absorption trench and on the same elevation. The reviewing authority may require the placement of the well(s) in an exact location. Additional observation wells may be required if the recommended observation sites show ground water higher than 6 feet below the ground surface.

Installation Process

1. The well must be installed vertically into a dug or drilled hole.

2. A slotted water well pipe should be used that is 2 to 4 inches in diameter and 10 feet long.

   A. Slotted pipe (PVC is the most common material) with slot sizes between 40 and 100 (i.e. slot widths between 0.04 and 0.10 inches wide) is suggested. Slots should be horizontal and spaced at intervals less than or equal to 0.5 inches.

B. Check with the reviewing authority to determine if an alternate well material is acceptable.

3. The pipe should be perforated from 1 foot below ground surface to 8 feet below the ground surface unless multiple horizons exist.

4. The casing must be unperforated 1 foot below ground surface to the top of the well. The well must extend at least 2 feet above the ground surface.

5. The top of the well must be sealed with a watertight cap.

6. The area around the well must be backfilled with native material to 1 foot below ground surface.

7. The well must be sealed in such a manner that prevents surface runoff from running along the outside of the well casing. The well should be sealed from 1 foot below ground surface to slightly above grade to allow for subsidence and to maintain a positive ground slope away from well casing. The material used to seal the well can be either fine-grained material or bentonite.

8. Each observation well should be flagged to facilitate locating the well and labeled with the lot number, location, and subdivision name.

Measuring Procedures

Lower a measuring tape or stick to the water level and measure the distance from the water level to the top of the pipe (see example, the next page). Water levels should be measured to the nearest inch. A plunking device or electronic water sensor can also be used. Data should be submitted in a similar form to that of the example.

Measure the distance from the top of the pipe to the natural ground surface; this is B distance (see example). Then measure the distance from the top of the pipe to the water level; this is A (see example). Subtract B from A; this value equals the actual separation between the water table and the natural ground surface.

Groundwater Observation Results

Monitored By:

Location :

Section ___________ Township__________ Range______ Lot #______

Observation Well # _________

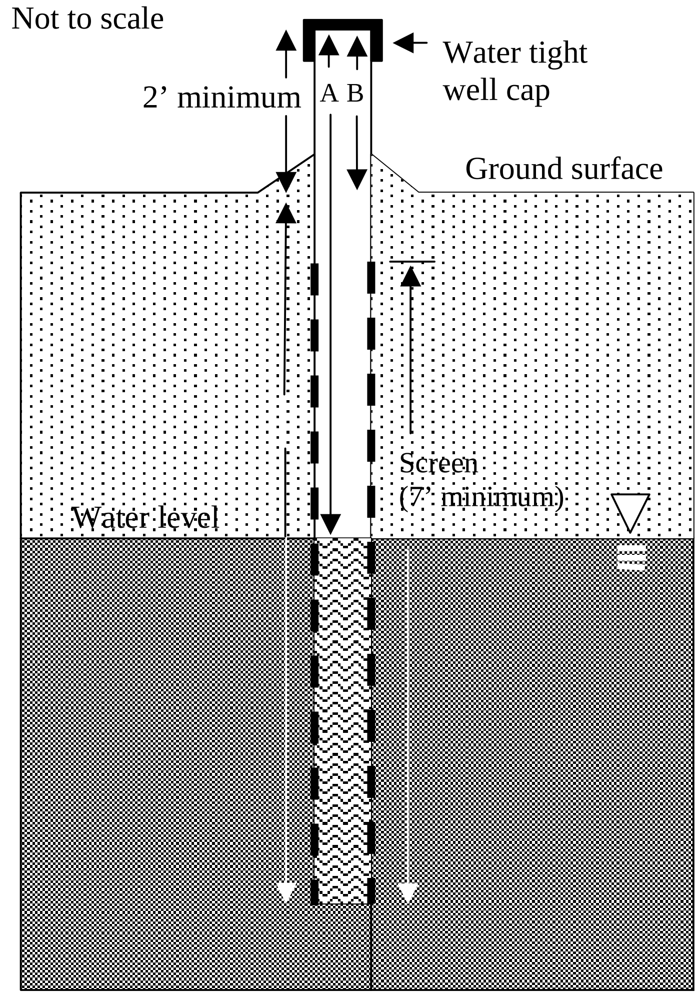
Other Location Information:

Date	Time	A (inches)	B (inches)	A-B (inches)

A= Distance from top of casing to the groundwater level in pipe (inches). Note: If the observation pipe is dry, enter the total depth measured and “dry” in this column.

B= Distance from top of casing to the natural ground surface (inches).

Groundwater Observation Well Design



APPENDIX D

OPERATION AND MAINTENANCE PLAN

Wastewater treatment systems are to be operated and maintained in accordance with the manufacturer's instructions, unless a written exception to those procedures has been approved by the reviewing authority and the product manufacturer.

The owner of the residence or facility served by the system is responsible for assuring proper operation and providing timely maintenance of the unit. The septic tank or other primary or settling tanks must be pumped as specified by manufacturer and in accordance with Chapter 7.

The authorized representative for the system must instruct or assure that instruction regarding proper operation of the system is provided to the owner of the residence or facility.

If observations reveal an absorption trench failure or history of long-term, continuous, and increasing effluent ponding within the absorption trench, the owner of the system must take appropriate action, according to the direction and satisfaction of the reviewing authority, to alleviate the situation.

A service contract for on-going service and maintenance of the entire wastewater system is required. Continued service and maintenance must be addressed for the life of the system by an operation plan.

Owner's manual

A comprehensive owner's manual must be submitted to the reviewing authority for the wastewater system. The manual may be a collection of individual system component manuals. This document must include a system installation manual, an operation and maintenance manual, a troubleshooting and repair manual, and as-built plans with the name of the designer and installer.

The information in this manual must include:

A. A clear statement providing examples of the types of waste that can be effectively treated by the system;

B. Requirements for periodic removal of residuals from the system;

C. A course of action to be applied if the system will be used intermittently, or if extended periods of non-use are anticipated;

D. The name and telephone number of a service representative to be contacted in the event that the system experiences a problem;

E. Description of the initial and extended service policies;

F. Emergency contact numbers for service providers, pumpers, the local health department, and the reviewing authority.

Installation manual

The installation manual must be submitted to the reviewing authority and include:

A. A numbered parts list of system components with accompanying illustrations, photographs, or prints in which the components are respectively identified;

B. Design, construction, and material specifications for the system's components;

C. Schematic drawings of the system's electrical components;

D. A process overview explaining the function of each component and a description of how the entire system functions when all components are properly assembled and connected;

E. A clear description of installation requirements for, but not limited to, plumbing, electrical power, ventilation, air intake protection, bedding, hydrostatic displacement protection (floating in high ground water conditions), watertightness, slope, and miscellaneous fittings and appurtenances;

F. A sequential installation procedure from the residence out to the effluent discharge connection; and

G. A detailed start-up procedure.

Operations and maintenance manual

The system designer or manufacturer must provide comprehensive and detailed operation and maintenance instructions to the reviewing authority. The operation and maintenance manual must include:

A. A maintenance schedule for all components;

B. Requirements and recommended procedures for periodic removal of residuals from the system;

C. A detailed procedure for visually evaluating function of system components;

D. Safety concerns that may need to be addressed.

Service-related obligations

The entire wastewater treatment and disposal system must be assured proper O & M through an initial and renewed service contract for the life of the system or through other means approved by the reviewing authority.

A two-year initial service policy must be furnished to the owner by the designer, manufacturer or authorized representative with the following conditions.

A. The initial service policy must contain provisions for four inspection/service visits (scheduled once every six months over the two-year period) during which electrical, mechanical, and other components are inspected, adjusted, and serviced;

B. The service policy must contain a clause stating that the owner must be notified, in writing, about any improper system function that cannot be remedied during the time of inspection, and the written notification must include an estimated date of correction by the designer, manufacturer or its representative.

Service providers must maintain accurate records of their service contracts, customers, performance data, and time lines for renewing the contracts. These records must be available for inspection upon request by the reviewing authority. The reviewing authority may require copies of these records to be submitted.

The designer, manufacturer or authorized representative must make available, for purchase by the owner, an extended service policy with terms comparable to those of the initial service policy, which includes O & M service for the entire wastewater system. The service provider must notify the reviewing authority and local health department of service contracts that are not renewed.

In the event that a mechanical or electrical component of the system requires off-site repair, the local authorized representative must maintain a stock of mechanical and electrical components that can be temporarily installed until repairs are completed if repairs are expected to render the unit inoperable for longer than 24 hours.

Emergency service must be available within 48 hours of a service request.

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